ARCHIVES OF OTOLOGY.

TENSION ANOMALIES IN THE SOUND-TRANSMITTING APPARATUS OF THE MIDDLE EAR.[1]

By CLARENCE JOHN BLAKE, M.D., OF BOSTON,

PROFESSOR OF OTOLOGY, MEDICAL SCHOOL OF HARVARD UNIVERSITY.

THE marked discrepancies in the statements of writers of text-books on physics and of physicists themselves, as to the upper limits of human hearing power, permitted the inference that the organ of hearing itself had not been subjected to a sufficiently critical examination and that the real cause for the observed differences in hearing lay in the tension anomalies of the sound-transmitting apparatus itself.

A series of experiments of a very simple character, made nearly thirty years ago, proved the inference to be correct and showed that, while the upper limit of sound transmission of the normal sound-transmitting apparatus of the middle ear in the human subject was a fairly invariable one, very considerable variations, both above and below the assumed normal, were the results of changes, either in the tension of parts of the intact apparatus or of changes involving solutions of its continuity.

The results of these experiments have been confirmed by later and more elaborate investigations, on the part of other observers, but the subject is still young and affords a varied, an interesting, and, for the progress of otology, an important field for original investigatory work.

The paths for the passage of sonorous vibrations to the percipient organ are so many, and the provisions for com-

[1] Read before the Section of Otology at the New York Academy of Medicine, March 13, 1902.

pensatory functions so varied, and the questions as to aërial and bone transmission, mechanical transmission, and the transmission of undulations through fluids in enclosed spaces are so closely related to each other as to make a long series of observations along more or less parallel lines and an equally extensive series of control experiments necessary to the arrival at any definite conclusions as to the exact functions of the sound-transmitting apparatus of the middle ear in the human subject, and the paper which you do me the honor of receiving and considering this evening is merely a short and a tentative step in this direction.

Coördinately considered, in reference to its functions, the normal sound-transmitting apparatus of the middle ear may be regarded as an acoustic balance with tension adjustments with its base, as regards tones of low pitch, outward, and its apex, as regards tones of high pitch, inward; as is illustrated by the fact that while the intact apparatus responds to, and transmits, tones no higher than those of from 45,000 v.s. to 50,000 v.s., attachment of the drumhead to the incus carries the transmission, and consequent perception, up to 65,000 v.s., while direct transmission of the sound waves to the stapes increases the limit to nearly, if not quite, 90,000 v.s.

Tension adjustment of the normal transmitting apparatus, afforded by voluntary contraction of the intrinsic muscles, carries the transmission limit but from 5,000 v.s. to 10,000 v.s. higher than the stated average, and beyond this point the intact drumhead and ossicular chain may be regarded as an obstacle to the transmission of tones of high pitch as well as a control apparatus of the intra-capsular transmission of sonorous vibrations received through the adnexa; and it is both as a transmitting apparatus and as a control apparatus that the membrana tympani and ossicular chain, with its attachments, must be regarded in the exact determination of any question in physiological acoustics, in which it is concerned.

A study of the effects of tension anomalies upon the transmission of musical tones implies, necessarily, a consideration of the excursions of the transmitting apparatus,

not merely as a whole but segmentally, and, with this point in view, regarding the malleus as a pivotal centre, the long arm of the balance is the posterior and the short arm the anterior, corresponding to the longer and the shorter sound waves respectively, and, while the rotating effect upon the malleus of contraction of the tensor tympani muscle is slight, its action is such as to increase the tension of the posterior segment of the membrana tympani in proportion to the greater laxity of that part of the vibrating mechanism.

Experiments on sound transmission in the normal ear in the living subject, made by weighting different portions of the membrana tympani, by the attachment to its outer surface of small discs of paper, show that it is in the posterior segment that the greatest effect is produced, and conversely, when this portion of the membrana tympani has been abnormally relaxed, the artificial restoration of tension produces the more obvious effects upon the hearing.

Clinical observations show that with a moderate degree of increased tension of the sound-transmitting apparatus as a whole, such as comes from increased atmospheric pressure from without, incident to closure of the Eustachian tube, there is an increase in the transmission of tones of high pitch, but that at a point at which the atmospheric pressure becomes so great as to have a damping effect the hearing for high tones immediately decreases, to the extent even of including the upper partials of the consonant checks.

Under these conditions the restoration of the patency of the Eustachian tube, without forcible inflation of the middle ear, and the reversal of the effect upon the sound-transmitting apparatus, by gradual exhaustion of the air in the external auditory canal, affords an opportunity for observation of the progressive restoration of the hearing for tones of higher pitch, the hearing for tones of lower pitch, with exception of the lowest limit, having remained throughout practically undisturbed.

It being assumed, on the basis both of anatomical structure and accredited experimentation, that the posterior

segment of the membrana tympani responds in vibration especially to tones of lower, as well as, partially, to tones of higher, pitch, it stands to reason that the conservation of the tension of this portion of the sound-transmitting apparatus is most important to the proper transmission of the medium and compound tones within whose limit the speaking voice is represented. The relationship (of the malleus, with its tension adjustment) to this posterior segment may be taken as confirmatory evidence, for in no other part of the membrana tympani is especial compensatory provision for the maintenance of tension, beyond that effected by contraction of the tensor-tympani muscle upon the sound-transmitting apparatus as a whole, provided.

With its larger surface and lesser initiative tension, the posterior segment is especially liable to tension anomalies to a degree beyond the limit of normal compensation, and it is entitled therefore to more careful consideration than is sometimes accorded it by the clinician, for, given a stretching of the posterior segment beyond the point at which it counterbalances the continued traction of the tensor-tympani muscle, a malposition of the whole ossicular chain occurs, with a resultant interference with sound transmission, which makes itself especially evident in the decreased hearing for those qualitative overtones which demand accommodative provision for their proper transmission.

Measurements of the posterior segment, in its relation to the malleus, show that the shortest arc of vibration corresponds to a line drawn from the manubrium just below the short process, running at an angle of about 45° to the long axis of the manubrium, to the periphery, this being the point at which the membrane begins to rise from the level of its uniform convexity for attachment to the upper part of the manubrium and the base of the short process, and its posterior ligament; from this point downward the lines of measurement gradually lengthen, reaching their maximum, in the majority of cases, at about the middle of the posterior segment. An examination of the structure of the membrana tympani, in this portion, also shows an area close to, and following, the curve of the periphery, in which the paucity

of circular fibres and the arrangement of the radiating fibres of the membrana propria are such as to render this portion much thinner than the general area of the posterior segment; it is widest and thinnest at the posterior superior periphery and gradually decreases in width and increases in thickness toward the posterior periphery, and it is precisely here that the objective symptoms of relaxation of the posterior segment, from undue tension, first show themselves, and are easily demonstrable on forcible Valsalvian inflation. In such instances it is interesting to note not only the effect upon the hearing in the decreased perception of qualitative overtones and the corrective result of the application of adherent paper discs or strips attached to the inner end of the canal and the thicker portion of the posterior segment, thus bridging over the relaxed portion, or of the application of contractile collodion to the relaxed part, but also to observe the peculiar relation which the stretching of the membrane has, not only to the perception of qualitative overtones, but even to the production of the voice in singers; stretching of the posterior segment of the membrana tympani being a not infrequent accompaniment of the flatting of the singing voice at points in the register in which the appreciation of qualitative overtone values is of especial importance, and not merely an accompaniment but a cause as well, as is easily demonstrated by an artificial restoration of the tension of this portion of the membrane, with a correspondingly immediate restoration of the quality of the voice.

The opportunities for the clinical observation of tension anomalies and their effect upon the transmission of musical tones have been largely increased since the introduction into general use of the various forms of pneumatic massage apparatus, which, while exceedingly valuable in some cases, are prone to over-use because of the readiness and simplicity of their application and the temporary relief afforded the patient by the consequent mobilization of the sound-transmitting apparatus as a whole, but it should be borne in mind that precisely as the ultimate expenditure of energy in phono-massage bears upon the ultimate vibratory and the perceptive apparatus, the proximate expenditure of energy

in pneumo-massage comes upon that portion of the membrana tympani most subject, from its intrinsic structure and larger area, to the deleterious effect of excessive excursion mechanically induced. In this connection there is another point which has been made the subject of observation and which deserves more exact investigation. Repeated succussion of the membrana tympani, even to the limited degree induced by the auto-massage of Hommell, the volume of air in the canal being estimated at 1 *cc*, seems to stimulate contraction of the tensor-tympani muscle to an extent which materially decreases the mobility of the sound-transmitting apparatus, and correspondingly lowers the hearing for qualitative overtones. Experiments in this direction on the normal ear in which the auto-massage was continued for several days, at short intervals, resulted in a decrease of the hearing as mentioned, its restoration occurring only after a long period of rest or after the gradual exertion of a counteracting intra-tympanic pressure incident to the application of the familiar Politzer plug.

Forcible inflation of the middle ear, which is much less the practice now than formerly, and Valsalvian inflation, unless often repeated and long sustained, produce no more deleterious effects upon the vibrating mechanism of the middle ear than does the pneumo-massage apparatus with its direct application of a to-and-fro movement under the pressure of from 0.1 to 0.6 of an atmosphere.

Still another tension anomaly, less frequently observed, is that which occurs when a thickening of the membrana tympani itself serves to conserve the tension of its different portions and the expenditure of what may be termed a misplaced energy comes upon the malleo-incudal articulation. Repeated and forcible movements of the membrana tympani outward, especially when that membrane is thickened and interstitially resistant, serve in time to stretch the tendon of the tensor-tympani muscle and thus permit an exaggerated movement of the head of the malleus. This movement in its turn stretches not only the capsular ligament of the malleo-incudal articulation but also the lateral protective ligaments, or check bands, of the malleus, nor does the diffi-

culty end here, for the repeated shocks from the inferior elevated border of the lower facet of the malleus upon the incus, tend to impair the integrity of the incudo-stapedial articulation under the uncounteracted contraction of the stapedius muscle.

For the purpose of determining the air pressure incident to the ordinary use of the pneumatic massage, two instruments were chosen as being those in most common use, the Sieglé pneumatic speculum and the masseur of Delstanche fils.

The Sieglé speculum was worked by means of a Reiner rubber bag 5.50 centimetres in diameter; with ordinary light pressure between thumb and first two fingers, the reading on the mercury column in the U tube was 14.5 *cm* as the mean of five readings, equivalent to 197.2 grammes[1] to the square centimetre or a little more than $\frac{14}{16}$ of an atmosphere.

With the same instrument forcible pressure gave, as the mean of two readings 23.1 *cm;* 314.16 grammes to the square centimetre, or $\frac{23}{16}$ of an atmosphere.

With the Delstanche instrument giving a piston stroke of 20 *mm* the mean of two readings was 65.5 *cm;* 896.8 grammes to the square centimetre or a little more than $\frac{65}{16}$ of an atmosphere.

With the same instrument at a piston stroke of 10 *mm* and 5 *mm*, the mean of two readings gave 49.8 *cm;* 677.28 grammes to the square centimetre, or nearly $\frac{50}{16}$ of an atmosphere, and 35.1 *cm;* 477.3 grammes or a little over $\frac{35}{16}$ of an atmosphere, respectively.

In cases of this kind, with excessive relaxation of long continuance, the decrease in hearing for tones of high pitch, due to the failure of the short sound waves to find transmission, is coupled with a loss of the distinctive voice overtones, which often fails of recovery even after the integrity of the malleo-incudal articulation has been artificially restored by bringing pressure to bear upon the short process of the malleus.

The reparative power, which works as if under the direction of a special intelligence, is nowhere better illustrated

[1] One pound = 373.25 grammes.

than in the human ear, in the remarkable degree to which fibrous structures can reinstate in proper relationship their component parts and is the basis of the spontaneous recovery of many of the cases of tension anomaly which come under observation, and there could be no better opportunity for the study of changes of tension in a fibrous tissue than that afforded by the membrana tympani, with a perceptive apparatus behind it and a wide range of musical tones as the index scale of the acoustic balance.

Relieved of the variations in air pressure which have impaired its tension, and therefore left to itself, the stretched posterior segment of the membrana tympani, unless it has been stretched to a point of disruption of parts of its fibrous coat, speedily seeks to take up its own slack, a process which can be materially aided by one or other of two procedures, one seeking to protect and to maintain the stability of the membrane, and the other, in addition, to encourage its contraction, the first of these procedures being the application of the familiar paper discs and the second the application of contractile collodion.

Returning now to the proposition of the acoustic balance, it is plain that the tension adjustment of the membrana tympani has its set-off in the ligamentous and muscular attachments of the ossicular chain, the distribution of weight in the latter having been found to serve as a counterbalance under tension of its attachments, and that, therefore, with any loss of tension in the membrana tympani changes must take place in the remainder of the sound-transmitting apparatus.

When these changes are the result of a relaxation of the drumhead of mechanical origin, such as comes with repeated closures of the Eustachian tube and other variations of air pressure, they are, comparatively, easily relieved; but when coupled with the results of congestive or inflammatory processes in the middle ear the determination of the extent and location of the tension anomalies, and of their appropriate treatment, becomes a matter of difficulty, and therefore of especial interest.

Grossly speaking, fixation of the malleo-incudal articulation interferes more with the transmission of tones of high

pitch, and fixation of the stapedo-vestibular articulation with the hearing for tones of low pitch, but between these two extremes there are all possible variations, as might be expected in a problem with so many intermediate factors.

When, as the result of a chronic non-suppurative disease of the middle ear, the fixation of the sound-transmitting apparatus has been of long duration, the hearing, for the voice especially, has become much impaired, and there are also symptoms indicating not only an obstruction to the passage of sound in either direction, but evidence that the fixation of the sound-transmitting apparatus has reached a degree which exerts an inhibitory effect upon intra-labyrinthine transmission, in default of amelioration from treatment an exploratory tympanotomy may be resorted to for the purpose of determining, by tactile and tone test, the location and nature of obstructions which could not be detected by means of the latter form of test alone.

This operation, which has been heretofore sufficiently described, affords a means for exact diagnosis not otherwise attainable, at a minimum degree of risk to the remaining hearing, since no injury is done to the important parts of the membrana vibrans, and, after tactile examination of the mobility of the individual members of the ossicular chain, the flap, formed of the posterior segment of the membrana tympani, can be simply and accurately replaced with the assurance, if aseptic precautions have been duly observed, of a healing by first intention.

Early experience showed that this operation could be done without general anæsthesia, and later experience that it can be done without local anæsthesia, the patient, conscious throughout the whole procedure, being able to answer descriptively to the tactile and tone tests made during the course of the operation.

Among other experiences, illustrating the inhibitory effect upon the general hearing of extreme retraction and fixation of the sound-transmitting apparatus, an illustration afforded also in cases of stapes fixation following suppurative disease of the middle ear, is an improvement in

hearing in the ear not operated upon as well as a general sense of relief from pressure in the head.

Under the same causative conditions in many of these extreme chronic cases, the parts, if they have been mobilized merely, at the time of the exploratory tympanotomy, tend to return shortly to their former condition, and operative interference of a more final character becomes necessary, if anything is to be done at all; under these conditions the preliminary exploratory operation has served to determine the most serviceable course to be pursued, with the purpose of at least ameliorating a condition which is, to many patients, most burdensome, for, in all that pertains to this question of tension anomalies and their treatment, it should be borne in mind that a little help is sometimes of great importance to the individual who receives the improvement, while but a small percentage of the normal hearing is a large percentage of the hearing which the patient has at command. In the light of the brilliant surgical successes and major achievements in otology, the minor possibilities of help must not be forgotten, for, to aid toward wholesome and useful living is as much one of the duties of the medical profession as is the saving of life itself.

A CASE OF CEREBELLAR ABSCESS AFTER INFECTION THROUGH THE LABYRINTH. DEATH FROM MENINGITIS. AUTOPSY.[1]

By Dr. ARNOLD KNAPP, New York.

C. P., male, aged twenty-six years, was admitted to the New York Ophthalmic and Aural Institute on Jan. 22, 1892, suffering from purulent otitis media of left side, accompanied by severe headache and vertigo. The ear had discharged for many years, and the hearing had been much diminished. The acute symptoms had existed for several weeks.

On admission, depth of left canal is stenosed and occluded by a granulating mass apparently projecting from above and back. Thick and fetid pus escaped at the edge. No mastoid tenderness. The pain was referred to the side of the head. Presumably no hearing. No objective vertigo. Eyes normal. T. 102.4°. P. 110.

Operation, Jan. 24th. — At a short distance beneath mastoid cortex a cavity is entered filled by a cholesteatoma with a distinct limiting membrane. The cavity is a very much enlarged antrum, and extends down, out, in, and forward of the usual boundaries. The capsule of the cholesteatoma is easily stripped from the underlying bone, which appears smooth and polished. An irregular white structure occupies the site of the external semicircular canal; external to this the posterior bony wall of the auditory canal is defective and filled with granulations. On their removal, the facial nerve is exposed in its downward course, and a large defect exists in the anterior half of the external semicircular canal. The tympanum contains granulations, but no ossicles.

[1] Read in abstract, with demonstration of the brain and temporal bone, at the Otological Section of the New York Academy of Medicine, Feb. 13, 1902.

The oval window is enlarged and discolored; granulations can be seen in the vestibule. The external semicircular canal is removed posterior to the opened lumen, establishing free communication with the vestibule. No pus was found in the labyrinth, and there was no fistulous tract on the inner wall of the tympanum or antrum. The operation was completed, and the wound closed.

The patient subsequently appeared to be doing well, except that the temperature remained up between 100° and 101.6°, with corresponding pulse rate, occasional pain over the left brow, and insomnia. On February 9th, the temperature was down, and he was allowed to leave the hospital on February 14th. The wound in the depth had shown no tendency to heal.

The patient was readmitted on February 19th, as he had suddenly become worse, and complained of very severe headache and nausea. There was slight left facial paralysis, and nystagmus accentuated on looking to the affected side. No vertigo, but unsteady gait. The wound discharged considerable pus. T. 101.4°. P. 108.

Operation, Feb. 22d. — The wound was re-opened, and all granulations removed. No pus or fistula to be seen. Starting back of the facial nerve the wedge of bone covering the cerebellar dura was removed. A probe introduced between dura and petrous bone in various directions revealed only healthy conditions. The oval window was enlarged downward, and the promontory wall removed. The vestibule contained greenish granulations. The tegmen tympani and the adjacent bone to the superior semicircular canal were removed, exposing healthy dura. Finally, the cerebellar dura was incised; no unusual amount of cerebro-spinal fluid escaped.

During the following five days patient was at times restless, with some delirium; slightly stuporous, though always easily aroused. Eyes normal. Nystagmus, vomiting, facial paralysis more marked. Temperature between 99° and 102.8°. Pulse about 120. Some pain in the back of neck.

On the day following, his condition had changed for the worse. He was comatose, and passed urine involuntarily. The pulse dropped to 80, hard and full, though the temperature remained high. Lumbar puncture drew off a faintly clouded liquid, with increased leucocytes.

Operation, Feb. 28th. — The posterior surface of the petrous

bone was removed ; first, exposing a healthy sinus, then, proceeding inward, with the object of getting as near to the internal auditory meatus as possible, the semicircular canals and the cochlea were removed. The cancellous bone at the apex of the petrous pyramid was laid bare, and appeared congested and discolored, but there was no free pus. The cerebellar dura was incised horizontally ; congested meninges protruded ; the cerebellum was punctured in various directions with a knife without result. The dura of the middle cranial fossa was likewise incised ; puncture of the cerebrum revealed no abnormity.

The patient stood the operation well. Temp. 103° ; pulse 130 ; resp. 40. The symptoms of meningitis then became more pronounced, and patient died two days later.

Autopsy.—Purulent meningitis of convexity. Purulent infiltration at base, starting at the anterior perforated space, increasing on going back. The apex of the left lobe of the cerebellum is adherent to the dura on the posterior petrous surface at the site of the internal auditory meatus ; the brain is here discolored. The pons, crura cerebri, and fourth ventricle are bathed in pus. The ventricles are filled with a purulent fluid. In the left cerebellar lobe in the region of the flocculus there is a small abscess cavity about 2 x 1½ *cm*, which extends forward and upward about the restiform body, filled with thick greenish pus and without a capsule. This abscess is separated from the adherent area of brain by ½ *cm*, and seems to have communicated with or ruptured into the fourth ventricle. The brain otherwise is normal, likewise the sinuses. The contents of the internal auditory meatus are swollen, matted together, and discolored.

In this case of chronic purulent otitis and cholesteatoma, complicated with caries of the labyrinth, the infection travelled through the internal auditory meatus, producing a pachymeningitis with adhesion of the cerebellar tissue, a cerebellar abscess in the flocculus which in turn ruptured into the 4th ventricle. At the first operation the original site of the disease was removed and the labyrinth freely opened. The latter structure contained no pus but discolored granulations. The operation seemed successful, except that the fever continued, and for the presence of pain over the left eyebrow and insomnia. Then suddenly very severe headache, nausea, slight facial paralysis, and

nystagmus set in. As the labyrinth had unquestionably been affected for some time without causing any typical signs (except deafness), it seemed proper to search for an extension from the labyrinth and possibly a deep-seated extradural abscess before the meningeal symptoms became pronounced. This was done; the posterior and superior surfaces of the petrous bone surrounding the semicircular canals were exposed and appeared healthy, nor could any fistula be found. No particular change followed in the symptoms until, on the sixth day, the pulse-rate which had been 120 dropped to 80, the temperature remaining high, and increasing stupor set in. Lumbar puncture was almost negative, *i. e.*, the fluid evacuated was practically clear. These three features strongly suggested an abscess, and, from the nature of the infection, one presumably situated in the cerebellum, near the internal auditory meatus. An attempt was made to get as near to this region as possible; the entire bony labyrinth was removed, the cerebellar dura was broadly exposed and incised, and the cerebellum was freely punctured, but without success. At the autopsy the abscess was found in the flocculus at a point even internal and anterior to the internal auditory meatus.

According to Okada,[1] who has published the most recent and very exhaustive monograph on this subject, a preponderating majority of cerebellar abscesses follow labyrinth suppuration and only one third are secondary to sinus disease.

Nystagmus was the only pronounced localizing symptom present in this case, and was accentuated on looking to the affected side. There were no other ocular symptoms. The misleading similarity of symptoms due to labyrinth involvement and those present in cerebellar lesions has been commented upon.

As regards the method of operating, the general rule to attack the brain focus at the nearest point to the path of infection is being generally accepted. Jansen, Koch, and Trautmann have recommended the removal of the posterior surface of

[1] Okada: "Diagnose und Chirurgie des otogenen Kleinhirnabscess," Haug's *Klinische Vorträge*. Fischer. Jena, 1900.

the petrous bone, in other words the removal of the median wall of the antrum, in exploring for cerebellar abscess. The space between the sigmoid sinus and the posterior vertical semicircular canal varies, according to the researches of Okada and others, between 0.5 and 2 *cm*, and is generally sufficient to permit of an adequate puncture of the cerebellum. When the labyrinth is also involved, this area can, of course, be much enlarged. This was done in our case, and at autopsy it was seen that the posterior petrous surface had been removed to within 0.5 *cm* of the opening of the internal auditory meatus. Nevertheless, the abscess cavity was not encountered, owing to its unusually deep-seated and, it may be said, inaccessible location.

TOXÆMIA FROM SUPPURATION IN THE TEMPORAL BONE.

By Dr. H. EULENSTEIN, of Frankfurt a. M., Gy.

Translated and Abridged by Dr. Edwin M. Cox, of New York.

ACUTE toxæmia following suppurative processes in the temporal bone is not very common, and has often been considered together with pyæmia and septico-pyæmia from the same source. I do not wish to include those cases in which there is first a thrombus formation in the sinus or the jugular vein, with a subsequent breaking down of this, and thus systemic infection, but I wish to describe a class of cases in which there are no symptoms of pyæmia, but a sudden and rapidly developing general infection.

In 1895, Grunert and Meier called attention to the fact that the lymph vessels were the probable channel of infection for cases in which there was no sinus phlebitis, and in 1896 Körner also expressed this view. Later, Meier adopted the view of Leutert, as expressed in *Arch. für Ohrenheilk.*, Bd. 41, p. 264. It appears to me worth the trouble to collect the cases bearing upon this matter and also to add some of my own observations. I have not in mind those cases in which the septic manifestations are caused by an extensive sinus or jugular involvement, since these do not require further explanation, and are sufficiently well designated by the names, pyæmia and septico-pyæmia. The cases to which I wish to call attention are: two of Körner's (*Die Otit. Erkrank. des Hirns*, etc., ii. Aufl., p. 94), two of A. Fränkel's (*Deutsche med. Wochenschr.*, 1894, No.

9), one of Eulenstein's (*Zeit. für Ohrenheilk. Bd.*, 30, p. 308), and two of Stanculeanu and Baup (*Le Progrès Méd.*, August 29, 1899). To these cases, I can add a short description of another.

A. B., æt. 11, had severe typhoid in 1900, but has escaped the usual diseases of childhood. On April 30, 1901, patient became ill with pain in the neck and ear, and there was fever, and very soon, purulent discharge from the right ear. Patches appeared on the tonsils next day and diphtheria antitoxin was employed, so that in three or four days the tonsils were clean, though the fever persisted. Right mastoid sensitive but not swollen. May 4th, headache and a morning temperature of 40.1° C., were the only noteworthy symptoms. Discharge from right ear continues profuse. During the next three days the patient developed an exanthematous eruption, resembling measles, beginning in the mucous membrane of the mouth and thence extending over the whole body. After three days this became less, and the temperature fell to almost normal, but the discharge from the ear continued profuse. On May 10th, there was a rise of temperature to 39.2° and the mastoid tenderness increased somewhat, so that operation was decided on and carried out at once. The mastoid cells were filled with pus and in some places with granulations, and the disease extended backwards as far as the sinus, which by the carious decay was exposed for a distance of $\frac{3}{4}$ *cm.* The wall of the sinus was accidentally torn at this spot and it was necessary to control the hemorrhage by tamponade. All of the diseased bone was removed as completely as possible and the usual dressing applied.

Two days after operation, May 12th, temperature 37.9° C., pulse 100, general condition very satisfactory. Early the next morning, the patient suddenly became worse, the pulse and temperature both rose, but the sensorium was so far unaffected. Later there was some improvement, but only for a time, when a sudden collapse occurred from which there was no rally in spite of vigorous stimulation. Six hours after the beginning of these symptoms, death.

The *Autopsy* showed some swelling of the spleen and moderate œdema of the lungs, but nothing in the head beyond a little serous infiltration of the brain, and a small area of nodular infiltration in the wall of the lateral sinus.

This case presents several points of interest. The occurrence of the exanthem, almost undoubtedly measles, at the particular time was remarkable, and probably contributed to the unfortunate outcome of the case. The possibility of an attack of measles had been considered, but since the eruption was delayed, we must attribute the first fever to the suppuration in the mastoid. The course of the eruption was like that of true measles, and not like that of an eruption due to sepsis. The involvement of the wall of the sinus was inconsiderable, and, judging from the appearance, only in its early stages. The toxæmia, therefore, did not result from the breaking up of a thrombus, but rather from the growth and development of bacteria in the blood after they had reached that fluid by penetrating the walls of the sinus.

The rapid course of the disease was due to the great virulence of the infecting organism, which did not allow time for the development of a thrombo-phlebitis and pyæmic symptoms.

Among the eight cases which I have mentioned as being similar to the one under consideration, there were two with chronic aural suppuration, and six with acute, and the ages varied from seven to forty-three. In two cases there was extensive infiltration in the region of the ear, which Körner looks upon as an evidence of a serious septic process. The time of illness varied from one day to three weeks. The fever was irregular and not characteristic, and chills occurred in only one case. Metastases did not occur; albuminuria occurred twice, and jaundice three times.

When the symptoms began, they, as a rule, became rapidly severe, and gave the impression that the toxines were cumulative in their action. Death usually occurred in deep coma.

In six cases radical operation was attempted, but in no case was permanent benefit attained, since every patient died. The autopsies naturally afford some points of interest. In nearly all the cases the organs of the chest and abdomen showed unimportant lesions. In two cases there were evidences of some thrombo-phlebitis, while in the other six there were no such signs, and in the few cases in which the jugular vein was examined in its entirety there were no gross

signs of disease. In three cases, the bacteriological examination showed streptococci, and in the five others nothing.

These observations show that suppurative disease in the temporal bone may cause general infection in two ways. The inflamed wall of the sinus may permit the passage of the bacteria or their toxines into the blood, so that death may occur from toxæmia without any special increase in the inflammatory process, or the bacteria may be taken directly into the circulation by the large, and especially the small, vessels, and thus be permitted to increase with great rapidity in all parts of the body. We do not yet know why the same kind of micro-organism behaves with different degrees of virulence under different circumstances, though individual susceptibility must play some part. Powerful stimulation and saline infusion are important parts of the treatment, but the value of the antitoxic serums is not yet settled. In all cases it is important to remove the focus of infection as soon as possible.

THE INFERIOR OCCIPITAL PLATE OF THE MASTOID, WITH ESPECIAL REFERENCE TO BEZOLD'S MASTOIDITIS.

By JOHN DUNN, M.D., Richmond, Va.

BOTH in observing the occasional cases of Bezold's mastoiditis one meets in practice and in reading those reported, one is struck with the fact that some cases, after operation on the mastoid and after opening the deep abscess in the neck, get well uneventfully, while others develop complications and die. Of the latter kind, I recall in my practice two cases, one of which has been reported in these Archives; the history of the other, in brief, was as follows:

Right-sided mastoiditis of several weeks' standing. When first seen there was a deep abscess in neck in addition to marked evidences of mastoiditis. Mastoid and abscess in neck opened. Mastoid found to be filled with pus. Symptoms did not improve. *Right* lateral sinus bared and found to be healthy. Abscess in neck further opened. One week later swelling appeared along line of *left* jugular. Patient would not give his consent to further operation. Symptoms of thrombosis; meningitis; death. Autopsy. *Left mastoid, antrum, cells, and middle ear* perfectly healthy. *Left* sigmoid and lateral sinuses filled with pus; pus in *left* posterior fossa of skull. Disintegrating thrombosis of *left* jugular. Brain not examined.

Compare very interesting similar case reported by Dr. H. Knapp.[1]

Professor Guye[2] refers to Bezold's original article, and

[1] Arch. of Otol., xxi., 239.
[2] Arch. of Otol., xxi., 318.

says that "this new method of extension consists in an abscess deep in the mastoid process, *perforating on the medial side.* The pus does not reach the surface, being prevented by the various muscular attachments on the outer surface and tip of the mastoid process." "Bezold produced this peculiar process artificially in the dead subject by opening the mastoid process externally, then perforating the medial wall with a gouge and injecting thick colored solutions which spread in the same manner as the pus." Knapp[1] reports a case of "the so-called Bezold variety of mastoiditis, viz., the pus had made its escape *through an opening in the medial side of the tip* of the mastoid into the digastric groove and the head of the sterno-cleido-mastoid muscle." In this case there was found a "small but distinct perforation leading into the digastric groove." In remarks on this case Dr. Knapp again refers to the perforation "*on the medial side of the tip* and extending down the neck alongside the sterno-cleido-mastoid muscle." Moos[2] says that Bezold "was the first to call attention to the fact that a mastoid abscess might open *toward the digital fossa* or *upon the internal* (medial) *surface of the mastoid process*, instead of externally. An anatomical disposition to such a course exists in those cases in which the lower portion of the mastoid process consists of a single large pneumatic cavity or of several such spaces bounded *internally only by a thin layer of bone.*" Hegetschweiler[3] speaks of "acute empyema of the mastoid portion of the temporal bone, proceeding, in the manner described by Bezold, to perforation of the *inner wall of the mastoid process.*" Guttman mentions "this type of mastoiditis, where the pus in the mastoid process has a tendency to break through the *lower inner table* of the mastoid process." Thus we see the accepted explanation of the so-called Bezold's mastoiditis takes into consideration only the "medial side of the tip" of the process.

If we examine a series of temporal bones we find in far the greater number that the mastoid has a well defined project-

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[1] ARCH. OF OTOL., xxi., 239.
[2] ARCH. OF OTOL., xix., 161.
[3] ARCH. OF OTOL., xxvi., 313.

ing tip, on the inner side of which above is a deep groove, the digastric, and that internal to this the mastoid extends until it articulates with the occipital bone. This inferior occipital plate of the mastoid, if it may be so-called, is from one sixth to one quarter of an inch wide, and has a portion of the sigmoid sinus just above its inner table, and even projects beyond the sinus wall posteriorly. In a few cases we have no well defined tip to the process, no "medial side of the tip." The process in these cases is bulky and extends well back to the occipital suture; the digastric groove being represented by a slight indentation on the under surface of the mastoid. Here the inferior occipital plate is proportionately well developed.

In a very considerable proportion of cases *the inferior occipital plate contains air cells connecting with those in the process.* This is nothing new and yet one rarely sees in the details of reported mastoid work mention either of the inferior occipital plate of the mastoid or of its air cells. The digastric groove is the dividing line between the inferior occipital plate of the mastoid and the mastoid tip. We see further that the greater part of the outer table of the inferior occipital plate lies at a considerably lower level than the highest part of the digastric groove; and, moreover, the medial side of the tip is in many skulls from three eighths to half an inch from the occipital suture. The bone occupying this whole space, which is made up of the digastric groove and the inferior occipital plate of the mastoid, may be filled with air cells communicating among themselves and with the air cells of the mastoid. It is highly probable that purulent osteitis of this occipital plate with its air cells exists in the severer forms of Bezold's mastoiditis, and that the rupture takes place through its inferior, *i. e.*, outer table, and pus thus reaches the deepest structures of the neck. The operation for mastoiditis, as usually done, is ineffectual because, although "the entire tip and all the cells above it" be removed, the diseased portions internal to the tip, *i. e.*, the bone and cells constituting the inferior occipital plate of the mastoid, are left untouched. Perhaps all of us can recall cases operated upon for purulent mastoiditis where delay of healing was caused

by a slight discharge of pus from the infero-posterior part of the wound. Here we had failed to explore the region above mentioned. There is another point we should bear in mind, viz.: the cells of the inferior occipital plate when full of pus must, because of the digastric groove, drain "up hill," unless the inferior table of the inferior occipital plate be perforated, in which case they empty their discharge into the deeper structures of the neck. The above observations may help us to understand why some cases of the so-called Bezold mastoiditis get well so readily, and why some are among the severest types of mastoiditis. In the former the rupture takes place through the medial side of the tip and before the structures in the posterior fossa become involved. In the latter the cells of the inferior occipital plate are diseased, and their drainage is worse even than that of the cells of the process, for it takes place through these latter; rupture of the tables for these cells means entrance of the pus inwardly into the posterior fossa either into the sigmoid groove or posterior to it, or, outwardly, into the deepest structures of the neck. Thus we see why the worst cases of Bezold's mastoiditis are often accompanied by meningitis of the posterior fossa, cerebellar abscess, and sinus thrombosis. From this we should learn to lay open freely the air cells of the inferior occipital plate in every bad case of Bezold's mastoiditis, and in every mild case where during operation we cannot find the direct perforation of the medial side of the tip to explain our deep abscess.

P. S.—The term inferior occipital plate of the mastoid has in the above article been used to signify that part of the temporal bone which lies internal to the digastric groove, its posterior boundary being a line at a right angle to the posterior end of this groove. The continuation upwards of this plate might be called the superior occipital plate of the mastoid, and while this plate also at times contains air cells and is the seat of extensive osteitis, it bears only indirectly upon the questions presented by Bezold's mastoiditis. The superior and inferior plates are directly continuous and the arbitrary dividing line has been selected only that this important part of the mastoid may in the future have a definite name.

SUPPURATIONS IN THE LABYRINTH.

By Dr. VICTOR HINSBERG,

ASSISTANT AT THE POLICLINIC FOR EAR, NOSE, AND THROAT DISEASES IN BRESLAU.

Abridged and Translated by Dr. RICHARD JORDAN, New York.

OUR knowledge of the suppurations in the labyrinth following otitis media is still very incomplete, although some valuable articles on the subject have been published in the last few years. It would appear that the labyrinth suppurations outnumber all other complications of middle-ear diseases and that they are at least of equal importance; yet, a general description of these suppurations remains to be written. I purpose to point out in this article the defects in our knowledge and to compile the abundance of isolated experiences. The records of our Policlinic afford some valuable additional data on the subject. In treating the matter systematically from different standpoints much repetition is unavoidable and may be excused.

I.—ETIOLOGY.

We know that the labyrinth can be infected in several ways: from the blood, from the cranial cavity, and from the middle ear. Only the last mode of infection will be considered in this article. Open pathways, such as lead from the cranial cavity to the labyrinth, do not exist between the latter and the middle ear. The two openings in the osseous labyrinth wall, foramina rotundum and ovale, are closed by membranes which resist the progress of an infection as strongly as the osseous wall itself. Politzer (1) has shown the existence of anastomoses between the blood-vessels of the middle and

internal ear, suggesting the possibility of an infection through these channels. But I have failed to find a single case in literature where a suppuration of the labyrinth was found to have been caused in that way. We may presume, then, that a labyrinth infection from the middle ear is only possible through a perforation of the labyrinth wall.

The perforation may be of *traumatic* origin. Fractures of the base of the skull are very apt to extend through the petrous bone, with or without rupture of the tympanic membrane. Thus the way is opened for the immigration of micro-organisms from the external ear or from the Eustachian tube. Occasionally injuries occur acting directly on the labyrinth wall—knitting needles being most commonly reported as the cause of the accident. Most authors assume that the needle was forced into the vestibule through the foramen ovale and Fedi (5) could confirm this by an autopsy three years after the accident occurred.

Under the head of traumatic lesions we have to consider those caused by *operations*, the labyrinth being opened either *intentionally* or *accidentally;* the former seems to be attended with less danger. Of all the reported cases of extraction of the stapes, only one (Evers, 6) developed symptoms suggestive of labyrinthine infection. Although no fatal results of the operation have been reported, its danger should not be underrated. The puncture of the foramen rotundum, which also has been recommended for the sake of improving the hearing, seems an even more hazardous proceeding.

The healthy labyrinth has been opened when an intralabyrinthine suppuration was thought to be present. I could find no such reports in literature; our own experiences of this kind will be reported farther on. The operations were not followed by any serious symptoms. Far more dangerous than intentional operations on the labyrinth are *accidental* injuries.

The numerous fatal cases where meningitis followed the unskilful attempt at *extraction of foreign bodies* are mostly due to a perforation of the labyrinth wall. The frequency of such occurrences cannot be stated even approximately,

as the majority of cases are not reported. The same may be true to some extent of the injuries occurring in *radical operations.* In special danger of being injured during this operation are the horizontal semicircular canal and the oval window with the stapes. In the early times of mastoid surgery, when the trephine was forced into the bone beyond the reach of the controlling eye, the chances of an accidental injury to the horizontal semicircular canal were considerably greater than they are to-day. Schwartze (10) has reported a case where in a desire to reach the antrum he pushed the drill deeper than he intended. Patient had severe vertigo immediately after the operation. The autopsy showed a perforation of the horizontal semicircular canal. The three canals and the vestibule contained pus. The cochlea was free from pus. The cause of death was sinus thrombosis.

Modern technique has materially reduced, but not entirely eliminated, the danger of such injuries. In cases of extensive destruction or anatomical anomalies, accidents might happen even to a skilful operator. Jansen (11) has reported nine such cases in his experience. The symptoms which followed were very characteristic and will be considered farther on. The hearing was not always diminished. None of Jansen's cases died as a result of the accident. In the majority of cases the symptoms disappeared within four weeks. Another accident occurring in radical operation is the dislocation of the *stapes*, caused as a rule by a somewhat aggressive curettement of the tympanic cavity. It is well to bear in mind that the stapedial region ought to be avoided in this procedure. Ossiculectomy through the external meatus also involves some danger to the stapes. About twenty-five cases of unintentional removal of the stapes have been reported; another case occurred in our clinic. In most cases the accident was not followed by any untoward results; in two of the reported cases diffuse meningitis set in following labyrinth suppuration. One case was published by Jansen; eighteen days after the accidental removal of the stapes his patient died from meningitis, the meninges having been infected from an empyema of the sacculus endolymphaticus. The other case is described by Grunert in the annual report

of Schwartze's clinic for 1895–1896. This case is of clinical interest inasmuch as the accident was followed by a period of marked improvement in the condition of the patient. On the eighth day, the pulse became somewhat irregular; on the ninth, vertigo set in; on the tenth, intense headache. On the fourteenth day, after a brief interval of apparent improvement, symptoms of diffuse meningitis appeared suddenly, to which the patient succumbed on the twenty-third day after the operation. At the autopsy the oval window was found open; the whole labyrinth was filled with turbid serum containing cocci. The infection had reached the meninges by way of the acoustic nerve. It is not improbable that a similar condition existed in other cases of meningitis after radical operation where no autopsy was performed. Of the two accidents occurring in radical operation, the dislocation of the stapes is decidedly more dangerous than the perforation of the semicircular canal.

Far more frequent than these labyrinth infections of traumatic origin are those which are due to the destructive action of *middle-ear suppuration.* It is difficult to estimate the frequency of such *destructive* processes. The experiences of recent years, however, have shown that labyrinth suppurations are a much more common complication of suppurations of the middle ear than they were supposed to be.

It is to be regretted that in the annual reports of the different clinics no column is allotted to these complications. In the first annual report of Koerner's new clinic (15), we see for the first time a division, "labyrinth suppurations following suppurations of the middle ear," with the subdivisions, "empyema of the endolymphatic sac," "empyema of the vestibule," and "operations on the labyrinth,"—a novel feature which ought to be generally adopted. I have compiled the cases of labyrinth suppuration reported in literature, being fully aware of the relatively small statistical value of such a compilation; for there is no doubt that many cases have not been diagnosed, and many of the diagnosed cases have not been reported. I have been able to collect the records of 198 cases where the extension of middle-ear sup-

puration into the labyrinth was demonstrated partly by clinical observation, partly by post-mortem examination. These cases are widely scattered in annual reports of private and public institutions, reports of operations, statistical compilations, etc. Not included are the cases of the Berlin clinic, published in two more elaborate and systematic reports — one by Jansen, "On a Frequent Complication of the Labyrinth in Suppurations of the Middle Ear" (11), and the other by Lucae, "On Carious and Traumatic Lesions of the Labyrinth" (16).

Jansen observed 137 cases of non-traumatic fistula of the labyrinth from 1889 to 1896, Lucae, 37 more from 1896 to 1899—a total of 174 in a period of ten years. The report fails to give the number of cases of middle-ear suppuration treated in the same period, from which the relative frequency of labyrinthine complications could be deduced. The 137 cases from the Berlin clinic will be considered apart from those collected by me. From the material of the Breslau Policlinic I can add the records of 22 cases.

Entrance of infection.—In only 61 cases out of the 198 of my collection, the entrance of infection could be located. The infection had entered through:

Fenestra ovalis	in 17	cases
Fenestra rotunda	2	"
Fenestræ rot. and ovalis	3	"
Fistula in horiz. semicirc. canals	27	"
Fistula in post. or sup. canals	5	"
Fistula on promontory	7	"

The infection is shown to enter the labyrinth most frequently through the horizontal semicircular canal, quite often through the oval window, rarely through the round window. The stapes may be completely or partially destroyed. In two of our cases (2, 20), no trace of the stapes could be seen under the microscope; in one (19), only the annual ligament was destroyed. In a case of Manasse's (59), one half of the foot-plate was missing and the opening filled in with granulation tissue. The comparatively rare destruction of the membrana secundaria is accounted for by its

well protected position. Lately Brieger (58) states that in 4 cases of labyrinth suppuration out of 5 observed by him the infection entered through the foramen rotundum. The report fails to give pathological details. As to the frequency of fistulæ in the horizontal semicircular canal as given in the above table, it must be considered that the observations antedate to a greater part the introduction of the radical operation. In order to realize the importance of the horizontal semicircular canal as a place of entrance, we have to study the reports of recent years. In the report by Lucae (61), the number of fistulæ in the horizontal semicircular canal is given as 32, against 4 defects in the "labyrinth wall."

The relation between the number of defects in the horizontal canal and the total number of chronic middle-ear suppurations observed in the same period has been estimated by different clinics from 1.06 to 1.2 %. The number of such fistulæ, however, compared with the number of radical operations, varies considerably in the reports of different clinics and different years, as shown in the following table:

	Radical operations	Fistulæ in ext. semic. c.	In %
Jansen (60)	100–120	25	20.8–25 %
Lucae (61, 16) 1896–99	202	32	15.8 %
Koerner (15) Oct., '99–Oct., 1900	34	2	5.9 %
Manasse and Wintermantel (52) April, '96–April, '98	77	9	11.7 %
Breslau Policlinic Apr., 1899–Apr., 1900 Apr., 1900–Apr., 1901	 33 26	 7 3	 21.2 % 11.6 %

While the frequent erosion of the horizontal semicircular canal is easily explained by its exposed position, it is difficult to see how the vertical canals which are not in contact with the middle ear can be invaded by a middle-ear process. And yet this happens not infrequently. Habermann (17), in the report of a carefully studied case of acute otitis, has first demonstrated how the infection extended from the middle ear through the petrous bone to the dura,—probably along the vessels in the fossa subarcuata. An extradural abscess developed, which eroded and broke into the superior semicircular canal, then into the vestibule, and from there through the oval window into the tympanum. We have observed a similar case, which will be reported elsewhere (Extension of suppuration through fossa subarcuata, erosion of posterior semicircular canal, cerebellar abscess). In a second case of Habermann's, one of the vertical canals seemed to have been eroded by an abscess in the petrous portion. Jansen reports 7 cases of labyrinth infection through the superior semicircular canal, and 5 cases of fistulæ in the common crus of the vertical canals, caused by a deep-seated extradural abscess. Such cases have to be well distinguished from those where the extradural abscess is the effect and not the cause of the infection of the labyrinth, although the resulting pathological conditions may be nearly identical. Another mode of labyrinth infection has been pointed out by Koerner (18). In virulent forms of acute otitis media, especially after scarlet fever, foci of extensive *necrosis* occur in the mastoid process as well as on the capsule of the labyrinth. In the latter case, a suppuration in the cavities of the labyrinth is inevitable.

Character of primary suppuration.—The infection of the labyrinth is far more frequent in chronic otitis media than in acute. In 89 cases out of my compilation, the middle-ear suppuration was acute in 18, chronic in 71, of which 21 were complicated with cholesteatoma.

In Jansen's 121 cases of defect in the horizontal canal, not one was due to acute otitis.

Jansen found cholesteatoma in 71 cases, tuberculosis of the middle ear in 16 cases. Reports of tubercular

infection of the labyrinth are not so frequent as might be expected.

Barnick (21) thinks that the gradual invasion of the labyrinth in tuberculosis would account for the absence of characteristic symptoms. Besides, the tuberculous character of the middle-ear suppuration is frequently not recognized. Of 33 well observed cases of labyrinth tuberculosis which Barnick found in literature, both fenestræ were opened in 5 cases, the oval window alone in 2, the round window alone in 3. Quite frequent is the perforation of the promontory, which is known to be the favorite seat of caries in middle-ear tuberculosis.

2.—PATHOLOGICAL ANATOMY OF LABYRINTH SUPPURATION AND ITS EXTENSION INTO THE CRANIAL CAVITY.

The pathological process following the infection of the labyrinth depends on the character of the primary suppuration and on the mode of infection. A sudden invasion of one of the larger cavities of the labyrinth by a virulent process will lead to a more rapid and extensive infection than the slow erosion of the osseous capsule in chronic suppuration. If the *whole* labyrinth is infected, all its cavities may be found filled with pus, the soft parts congested and swollen. Not infrequently, however, the exudation is insignificant, so that macroscopically no pus can be seen, while microscopical examination shows distinct and extended round-cell infiltration. This condition is commonly found in cases of circumscribed infection. The exudation becomes quickly organized by vascular connective tissue, which may promptly ossify.

Habermann (22) found new formation of bone in cochlea, internal meatus, and aqueductus cochleæ in a case of only seven weeks' duration. On the other hand, we find destruction of the osseous labyrinth. The whole frame of the cochlea may become detached and exfoliated. The nervous apparatus usually undergoes rapid destruction. The infection of the labyrinth does not necessarily extend into all of its cavities, but may remain *confined* to one of them.

Jansen (23) reports a case where the autopsy revealed a

"very small fistula in the anterior crus of the horiz. semic. canal; membranous canal congested and swollen; microscopic examination shows round-cell infiltration of its walls. Superior semic. canal, vestibule, and cochlea were normal, macro- and microscopically."

I found a similar condition in the following:

CASE 1.—P. K., age sixteen. No labyrinth symptoms. October 4, 1900, radical operation for cholesteatoma. Fistula in horizontal external canal. Chloroform asphyxia. Death. Microscopical examination: cochlea and vestibule free from inflammation, also both vertical canals; anterior crus of membranous horizontal canal is thickened and infiltrated, the posterior crus is entirely destroyed.

In a second case reported by Jansen (24), the suppuration was confined to vestibule and horizontal canal. Isolated affections of the horizontal canal are very common, according to Jansen's experiences. Brieger (58) takes a similar view. In the cochlea also, the infection may, for a time at least, remain localized within a certain section. Grunert and Zeroni (25) describe the microscopical appearance of a labyrinth in a case of meningitis: "While the rest of the labyrinth was found to be normal, the scala tympani was nearly filled with round-cells. The membrana secundaria was infiltrated and covered with a layer of round-cells on both sides."

Other cases of a partial infection of the labyrinth have been reported by Steinbrügge (26), Scheibe (4), Heine (29). The number of exact microscopical examinations is hardly sufficient to justify Jansen's somewhat sweeping statement that "as a rule the suppuration of the cochlea is shut off from the vestibule and *vice versa.*"

The *extension of labyrinth suppuration into the cranial cavity* usually follows the normal openings in the bone for the acoustic nerve and for the aqueducts, infection through the internal meatus being the most frequent. The endolymphatic sac can be distended to a considerable size (size of a bean in Jansen's case), "Empyema of Saccus Endolymphaticus."

Congenital *dehiscence* may be mentioned as possible pathways of infection. Dunn (30) at an autopsy accidentally found a dehiscence in the superior semicircular canal of a negro. Besides these pre-existing pathways, the suppuration frequently opens up *new ways* through the labyrinth capsule. The layer of bone covering the vertical canals may be destroyed, the infection thus reaching the dura and giving rise to the formation of extradural abscesses described by Jansen (31). Jansen mentions that most of these complications develop in the course of neglected *acute* suppurations. I was able to examine a case microscopically where the labyrinth suppuration was about to perforate the superior semicircular canal.

CASE 2, reported in full by Krischke (48). Protracted acute otitis media. Dizziness. Radical operation. Vertigo relieved. Pyæmic symptoms ten days after operation; death eight days later (jugular-bulb thrombosis).

Microscopical examination.— No trace of stapes found; young vascular connective tissue invading the vestibule from the tympanum. Semicircular canals filled with granulation tissue. Osseous wall at apex of superior canal is eroded, only a minute layer of bone separating its lumen from the dura.

In some rare instances, labyrinth suppuration may cause *jugular phlebitis* through the vena aqu. cochleæ or vestibuli. Jansen (24), in his article on sinus-thrombosis, mentions this possibility and cites a few cases where the infection occurred in that way. All pathways from the labyrinth lead into the *posterior* cranial fossa, the only exception being a perforation in the anterior crus of the superior vertical canal which might implicate the middle fossa. If the infection extends beyond the dura into the subdural space, *circumscribed* or *diffuse meningitis* or *brain abscess* results. Only cerebellar abscesses have been reported as caused by labyrinth suppuration.

3.—SYMPTOMS.

The symptoms of suppuration in the labyrinth may be caused (1) by the suppuration as such, (2) by the condition of the terminal nerve-organs contained in the labyrinth.

The suppuration as such may cause *fever*, but little is known about this symptom in labyrinth suppuration. In one of our cases (Case 15), where the infection of the labyrinth took place under our eyes, the temperature did not rise above 100.8° F. Other cases showed no increase in temperature. In most of Jansen's cases the labyrinth complication was not attended with fever.

More characteristic are the symptoms which are due to *irritation* or *annihilation* of the *function* of the labyrinth. According to Mach-Breuer's theory, the labyrinth contains two distinct terminal organs — the *acoustic* organ in the cochlea and the *static* organ in vestibule and semicircular canals. Irritation of the former causes subjective sounds; irritation of the static organ, vertigo and nystagmus. Destruction of the one causes deafness; destruction of the other, lack of balance. The latter condition has only been observed after the destruction of both static organs; after the destruction of only one its function seems to be taken up by the contralateral organ. Symptoms of irritation of the cochlear nerve have been observed in the incipient stage of labyrinth suppuration. Max (34), in a case of bilateral necrosis of the cochlea, noticed the following symptoms after the carious process had reached the left labyrinth: "After a short interval, during which the hearing was more acute than before (although the sounds perceived seemed to be changed in character), the hearing-power decreased very rapidly, with subjective noises and ringing, pain and giddiness." More important than this "*irritation*-symptom" is the "*destruction*-symptom" of defective hearing and deafness. Deafness was pronounced by Scheibe (28) the "constant and never-missing" symptom of labyrinth suppuration, a statement which has proved to be erroneous. Jansen has shown that very fair hearing is sometimes found in cases of isolated suppuration in the semicircular canals, and his observations have been confirmed by other authors. I can add two cases from our own material:

Case 3.—P. G., brakeman, age twenty-seven. O. m. p. c., A. S. Frequent attacks of giddiness. No nystagmus. Wh.: r. 5 *m*, l. 1.5 *m*. March 29, 1901, radical op.; fistula in horiz. sem. canal.

The dizziness increased during the following days, but ceased after the first dressing. Wound healed promptly. July 26th, hearing-test, left ear: wh. 2.5 *m*, Weber to left; upper limit, Galton, 0.8 : 3.7 = 16,435 v., lower l. D.

CASE 4.—R. R., age thirty-seven, farmer. O. m. p. c., A. D. (acute exac.). Dizziness and headache for a week. Hearing r. ear: wh. ad conch., V. 5 *m*. Weber to r. Galton 1. 1. Nystagmus. July 26, 1901, radical op.; fistula in hor. s. canal. Nystagmus and dizziness disappear promptly. Wound still under treatment.

In all these cases the cochlea was probably free from inflammation. Most patients with labyrinth suppuration, however, are absolutely or practically deaf on the affected side. Very interesting are the symptoms of *disturbed static function*—dizziness, objective vertigo, and nystagmus. The dizziness may be so severe as to confine patients to the bed, the slightest movement of the head causing the most distressing sensations. Patients that are able to walk show a staggering gait, or what Moos called the "duck-gait." These symptoms of disturbed balance may be continuous or may appear in periodical attacks; they may come on spontaneously or after certain movements of the head; frequently they become noticeable only when the eyes are closed. Mechanical irritation of a fistula in the semicircular canals may bring on a severe attack of vertigo. Lately exact and elaborate examinations and experiments on the disturbance of the static function of the labyrinth have been reported by v. Stein (36) and Adler (39). Jansen (11) saw symptoms of vertigo in fifty-seven out of ninety-seven cases of uncomplicated fistula of the horizontal canal; in twenty-two of these, walking was difficult or impossible. Lucae noted vertigo in thirty out of his fifty cases. In nearly all the cases collected by me, the reports mention symptoms of dizziness. Of the twenty-two patients recorded at our Policlinic, only three showed no signs of static disorders. Habermann (17), however, states that in eighteen cases of acute labyrinthine suppuration, only eight had dizziness and ten had none. That the severest symptoms of vertigo diminish gradually and

then disappear permanently has been frequently observed. An illustration and an explanation of this occurrence are presented in the following:

CASE 5.—S. D., twenty-three years. Recurrent otitis in puerperio. Pulmon. tuberculosis. Stupor, fever. R. proc. mast. tender and swollen; ear-canal stenosed; profuse discharge. July 18, 1900, radical op. Dec. 15, 1900, cavity epidermized, except small place on promontory, where rough bone is exposed. At the end of December, severe symptoms of vertigo appear suddenly. A deep fistula has formed on the promontory and is rapidly increasing in depth and width. The dizziness continues for six weeks with undiminished intensity; then it grows less and less and disappears altogether. Patient dies a few weeks later. Inspection of the wound shows that the cavities of the labyrinth are totally destroyed.

The question why the symptoms of dizziness are sometimes missing in cases where the vestibule and semicircular canals were positively diseased has not been satisfactorily answered. It may be that occasionally the maculæ and cristæ acousticæ in cases of circumscribed inflammation remain intact. But such a possibility would not account for the cases reported by Habermann (17), where macula acoustica and crista of the posterior canal were "necrosed and nearly destroyed," and where not the slightest sign of dizziness had been noticeable. Possibly Barnick is right when he states that the characteristic symptoms are missing in cases of very slow destruction. And the same might be true in very rapid extinction of the terminal apparatus.

The disappearance of vertigo after the membranous parts of vestibule and canals have been destroyed requires no explanation. The continuance of the symptoms could only be explained by a direct stimulation of the vestibular nerve [Barnick (38), has described such a case].

Vertigo is frequently accompanied by *nystagmus*. Jansen has first called attention to the frequency of nystagmus in labyrinth complications and has reported the result of his extensive clinical observations. The reports in literature collected by me contain nothing on the subject. Jansen saw nystagmus in every case of traumatic perforation of

the horizontal semicircular canal; in the 97 cases of carious perforation, the symptom is noted as absent in 19, as present in 24. Jansen thinks that the examination for nystagmus was simply forgotten or neglected in the remaining 54 cases. Lucae reports nystagmus present in 31 per cent. of 289 cases of fistula in the semicircular canal and in every traumatic perforation. Nystagmus without vertigo is rather rare (Lucae, cases 18 and 23); vertigo without nystagmus not infrequent. Nystagmus disappears sooner than dizziness and vertigo; it is mostly horizontal, seldom rotatory. The oscillations are increased when the eye is turned toward the non-affected side. Jansen mentions that nystagmus is occasionally inconstant, and that it may be absent or present at different times of observation.

Unequal width of the *pupils* has been noticed occasionally in labyrinth suppurations. Cohn mentions it in his article (42) on nystagmus and we saw it in Case 4. Whether the symptom has any value or not, will have to be shown by further observations. *Nausea* and *vomiting* are quite commonly mentioned in the reports on labyrinth suppuration and may be considered a characteristic labyrinth symptom. *Headache* however is so frequent in chronic and uncomplicated otitis media that it has very little diagnostic value.

4. — COURSE AND TERMINATION OF LABYRINTH SUPPURATIONS.

Acute forms of purulent otitis interna are well illustrated in many reports on cases of traumatic origin, dislocation of stapes, fracture of base of skull, etc. The infection of the labyrinth may rapidly spread to the meninges and terminate fatally within a few days. In other cases considerable time may elapse before the meninges become infected. In Politzer's case (40) of a fracture of the skull, extending through both labyrinths, the accident was followed by complete deafness and by severe vertigo, vomiting, etc., which kept the patient in bed for four weeks. Two weeks later, when Politizer saw him, he seemed perfectly well, excepting his deafness and his somewhat staggering gait. Six days

later, he had a sudden chill and died from meningitis after two days. Autopsy: Left tympanum normal; fissure through vestibule; labyrinth filled with pus. Infection extending through internal meatus. Right labyrinth, also opened by the fracture, contains some coagulated blood, but no pus. Here the meningitis set in seven weeks after the accident, without any warning and in the course of apparent recovery. In another case of Politzer's (2) the interval was twenty-eight days; in 2 cases reported by Scheibe (41), seven and sixteen days.

In other cases with alarming symptoms of meningeal irritation, the outcome has been favorable. In Schwartze's (43) case (injury with knitting needle) there was severe vertigo and profuse discharge of cerebro-spinal fluid. On the following day high fever set in with delirium and pain in the back of the neck. The alarming symptoms disappeared gradually after about three weeks. Recovery with deafness in the affected ear. The middle ear in this case was not infected, the labyrinth having been infected directly by the non-aseptic point of the needle.

Suppurations of the labyrinth following *scarlet fever* and other *exanthematous* diseases are usually of a very acute character: sudden appearance of severe vertigo and rapid loss of hearing function. These suppurations may heal spontaneously or may become chronic, frequently leading to *necrosis* of parts of the labyrinth. Out of seventy-eight cases of necrosis compiled by Oesch (19) twelve were caused by scarlet fever. Bezold's (35) report contains seven cases of exfoliation of the necrosed cochlea which were all due to scarlet fever. The time elapsed from the outbreak of the exanthema to the exfoliation was from one to thirty-nine years. The course of labyrinth infection in ordinary cases of acute otitis is usually less violent and sometimes very slow and latent. A case of Habermann's (17) with acute otitis media died from meningitis caused by suppuration of the labyrinth without having shown any symptoms whatever suggestive of an affection of the inner ear. A patient of Scheibe's (28) suddenly developed labyrinth symptoms after having been discharged as cured from acute otitis and mas-

toiditis (mastoid operation). He died three weeks later from meningitis.

Suppurations of the labyrinth from *chronic otitis media* may have a rapid course, but they are more often of a comparatively mild character. The onset, however, is frequently marked by more or less severe vertigo with nausea and vomiting. In *tuberculous* affections it has been noticed that the complete loss of the hearing function may precede the symptoms of static irritation—in accord with the slow progress of the inflammation through the promontory into the cochlea, and from there to vestibule and semicircular canals.

Intracranial complications of infections of the labyrinth are frequent. Of the 198 cases of my collection, the cranial cavity was infected in 108, and in 43 of these the pathway of the infection could be traced:

Porus acust. int.	in 25 cases.
P. a. i. and aqueducts	" 1 case.
Aqu. vestibuli	" 8 cases.
Aqu. cochleæ	" 1 case.
Fistulæ in vertical canals	" 8 cases.

The terminations in the reports were:

Recovery	in 92 cases.
Death from meningitis	" 60 "
From meningitis and brain abscess	" 6 "
From cerebellar abscess	" 13 "
From other complications	" 27 "

Of Jansen's 137 cases with labyrinth complication, 34 in all terminated fatally:

15 from meningitis.
2 from cerebellar abscess.
17 from other complications.

These figures show that *meningitis* is by far the most *frequent* complication of the suppurations of the labyrinth. In typical cases the diagnosis of lepto-meningitis is easily and promptly made, but under certain conditions, particularly in localized meningitis, the symptoms are not all characteristic, and the diagnosis may be difficult.

Case 6 (reported extensively elsewhere, 44). Radical operation with removal of sequestrum from the cochlea. During the otherwise normal convalescence an occasional rise of temperature and severe backache were noticed and a slight optic neuritis became more distinct. These symptoms remained unchanged for many weeks and aroused suspicion of a circumscript meningeal infection. Diffuse meningitis developed suddenly and took a very rapid course. At the autopsy a circumscript meningitis was found which had spread recently along the subdural space and the meshes of the arachnoid.

A number of interesting observations have been reported by Brieger (45). One of his patients with suppuration of the labyrinth had repeated attacks of severe headache, vertigo, slow pulse, fever, and homonymous diplopia. Every time these symptoms were greatly relieved by a lumbar puncture. Patient recovered. I agree with Brieger's opinion, that the symptoms were due to a localized meningitis. Brieger, as well as Jansen (46), calls attention to the fact that the symptoms are very similar to those described in "meningitis serosa," and that they are most frequently observed in cases complicated with labyrinth suppurations. When the labyrinth infection extends through one of the eroded vertical canals, additional symptoms may be expected from the formation of an *extradural abscess*. Jansen (13) noted "one-sided headache, frontal as well as occipital, no fever, occasionally stiffness of the neck." Other symptoms are: neuritis optica, slow pulse, somnolence, and crossed paresis (47). Of the greatest interest is the *influence of operations* on the middle and the internal ear on the course of labyrinth suppuration. The elimination of the middle-ear process is frequently sufficient to allay the inflammation in the labyrinth, sometimes after a short interval of post-operative exacerbation.

Case 7.—O. m. p. c., A. D. Vertigo for two weeks, increasing. November 1, 1900, chill. Temp., 39.3°. Nystagmus. Deafness A. D. Rad. op.: sinus covered with granulations. Fistula in horizontal canal. Temperature returns to the normal. Vertigo disappears gradually. Recovery.

In other cases, symptoms of labyrinth irritation appear or become more intense *after* the operation.

CASE 8.—O. E., age twenty-eight, laborer. O. m. p. c., A. D. No labyrinthine or intracranial symptoms. A large polyp is removed with snare and curette. The following morning: temperature, 101.3° F. Severe headache, vertigo, vomiting, slight stiffness of neck.

Immediate radical operation, September 19, 1899. Dura exposed by caries. Fistula in horizontal canal. Facial paresis after operation. September 20th. — Somewhat better. September 22d. — Temperature, 103°. September 22d–30th. — Temperature normal. R. eye: neuro-retinitis. L. eye normal. October 1st.— Temperature, 103.5°. Frontal headache. No retention in wound. October 5th. — Neuritis optica; also in left eye. October 7th–14th.—Even temperature up to 102.2°. Temperature normal after October 15th. No more headaches. Neuritis optica increasing until October 26th, when patient is discharged. Inquiry three months later; patient perfectly well and working.

In other cases the outcome has been less favorable, and it cannot be doubted that *operations* are sometimes responsible for the *extension* of latent *suppurations of the labyrinth* into the cranial cavity. Very instructive on this point is a report by Heine (29) of 63 fatal cases of uncomplicated meningitis observed in the Berlin clinic from 1887–1900; 22 of these infections were caused by labyrinth suppuration, and of these, some were not operated upon, others showed meningeal symptoms before the operation. In 10 cases, however, the first meningeal symptoms followed the operation very promptly. The primary suppuration was acute in 2, chronic in 8 cases. Symptoms of an affection of the labyrinth were present in 4 cases.

Brieger (45) and Gradenigo (49) have lately called attention to the danger of mastoid operations in cases of latent otitis interna.

Brieger (58) lost 5 patients from meningitis out of 169 cases where he performed the radical operation for prophylactic reasons. In all 5 cases the meningitis was due to a concealed suppuration of the labyrinth. I can report 3 cases where the mastoid operation probably caused the extension of the suppuration beyond the labyrinth (48).

CASE 9.—P. A., age nineteen. Mastoid operation for acute

otitis media. On the seventh day, sudden appearance of meningeal symptoms. Death eight days later. Autopsy: meningitis. Labyrinthitis.

CASE 10.—C. R., thirty years. Protracted acute otitis media, A. D. Slight facial paresis; no labyrinth symptoms. Radical operation. Six days later: strabismus diverg., nystagmus horiz., incip. neuritis optica. On next day, dizziness. Meningitis. Death eleven days after operation. Autopsy: diffuse meningitis induced from right labyrinth. Microscopical examination later.

CASE 11.—H., age thirty-eight. Radical operation for O. m. p. c., A. D., with granulations. Three days afterward, sudden vertigo, nystagmus, fever. Very severe meningitis. Death four days after operation. No autopsy.

In a case reported by Heine (29), meningitis developed immediately after a cauterization with chromic acid. The autopsy showed suppuration of the labyrinth as the cause of the meningeal infection. The relation of cause and effect is less apparent where a longer period elapses between operation and the first onset of meningitis. This period was twenty and forty days in 2 cases of Heine's report.

CASE 12.—W. S., age forty. O. m. p. c., with granulations. Treated in dispensary for some time; lately sometimes dizzy. May 31, 1900.—Radical operation; small cholesteatoma in antrum. Slight facial paresis, increasing during the following days. Severe dizziness for about a week. Wound heals normally, and is epidermized after six weeks. Patient pretends to be feeling perfectly well. Five days after his last call at the clinic we are informed that he had died suddenly two days ago. No autopsy. We learned afterward from the physician who saw the patient that he died under the typical symptoms of meningitis, and we were told by his relatives that he had suffered from severe headache since the operation, but that fear of another operation had prompted him to dissimulate his symptoms.

The results of operations on the labyrinth itself will be considered farther on.

(*To be concluded.*)

REPORT ON THE TRANSACTIONS OF THE SECTION ON OTOLOGY OF THE NEW YORK ACADEMY OF MEDICINE.

By Dr. JOSEPH KENEFICK, Secretary.

STATED MEETING HELD FEBRUARY 13, 1902.

EDWARD B. DENCH, M.D., CHAIRMAN *pro tem.*

Dr. Wendell C. Phillips presented a case of **Bezold mastoiditis without rupture of the drum membrane.** He said: I have just had an experience which is rather unusual, and it might interest the Section if I give the history of this case in brief. The patient was referred to me yesterday by Dr. McAlpin. She gave a history of severe pain in the ear for four weeks past, following an attack of grippe. Eight days ago the mastoid bone began to swell. When I saw the patient yesterday, there was external swelling and softening over the tip, indicating a Bezold case. But during all this time there had been no discharge from the external auditory canal. She volunteered the information that for some weeks she had felt pus in the throat. I gently inflated the ear, and I felt sure that I could see pus behind the drum, but there was no perforation. I sent her to the Post-Graduate Hospital, and this afternoon, under ether narcosis, I performed the typical mastoid operation. Previous to performing this operation, I made an incision through the drumhead, and thick, creamy pus followed upon withdrawing the bistoury. It was a typical Bezold case. Here we had a suppuration for four weeks, with the development of a mastoiditis and without a rupture of the drum membrane. The presence of pus I was able to demonstrate by incising the drum prior to operation.

Dr. Edward B. Dench: The case reported is certainly an interesting one. Cases of mastoiditis without involvement of the

tympanic cavity occasionally are met with, but they are rare. These cases which present the typical post-auricular tumefaction are not so common in my experience; they are more frequent when this sign is wanting. I can recall a case at the Polyclinic Hospital in which there was no pus flowing from the canal, absolutely no swelling over the mastoid, but there was tenderness and excruciating pain; in this case the mastoid was broken down. It seems to me that Bezold's perforation through the tip of the mastoid beneath the sterno-cleido-mastoid muscle explains the reason why so little pain and discharge from the ear is found; the pus is evacuated in another way. The discharge in the throat is interesting, and perhaps it does occur once in a hundred times, but in the other ninety-nine the patient is mistaken.

Dr. M. D. LEDERMAN reported the history of a **case, which clinically simulated mastoiditis, but on performing an exploratory operation no disease of the mastoid was found.** The patient, a female, complained of pain in the ear, with marked tenderness on pressure over mastoid antrum and tip. Though some discharge of the ear had occurred previously, according to the patient's statement, none was seen at the time of operation. A temperature of 100° F. was present, but on incising the membrane, no pus came away, and the distinct rip of going through a thickened drum was heard. There was some swelling over the mastoid at this time, though the picture of the drum and adjacent tissue did not indicate an acute inflammatory process. Opening of the mastoid was postponed for twenty-four hours, and Leiter's coil was applied. The next day the temperature reached 103° F., and the swelling with pitting was more marked, together with increased tenderness on pressure. No pus was seen in the canal, but as the mastoid symptoms had progressed, the bone was opened. No disease was found in the antrum or tip. The wound was almost entirely closed with sutures. As the temperature kept slightly elevated, a ten-grain dose of quinine sulphate was given morning and evening, which brought the temperature to the normal line. The patient finally gave a history of malaria, and after she was discharged from the hospital she had another attack with fever, chill, and sweat. The latter symptoms were not present while she was under our observation; if they had appeared we would naturally have suspected sinus thrombosis. The microscopical examination was negative. It is possible that obstruction in a tributary vein caused the œdema over the mastoid.

Dr. E. B. MEIERHOF read a paper entitled: **Does early treatment of acute inflammation of the middle ear prevent the more serious complications?** which is published in full in No. 1., p. 1, of this volume.

Discussion.—Dr. WENDELL C. PHILLIPS: It seems to me that the proper answer to the question asked in the title of the paper just read would be that the early treatment of acute inflammation of the middle ear, as a rule, prevents the more serious complications. I must say that I agree with the reader of the paper that the rule has many exceptions. A fairly large number of cases that come to us do not seem to be influenced, so far as the graver complications are concerned, by any local measures that we may apply. I have under treatment at the present time a case that resulted from a severe attack of grippe, which had lasted two or three days. On the third night there was a severe attack of otitis, the pain being very severe in character. The day following, I saw him, and found a bulging drum, and made a free incision. The ordinary measures of cleansing the canal were instituted and faithfully carried out. The next day the mastoid symptoms were quite marked, and had increased so rapidly that the patient was taken to the hospital. The ice coil was applied for twenty-four hours; by this time the mastoid symptoms had become so urgent that operation was no longer delayed. There was found an involvement of the entire mastoid process. Preventive measures employed in this case were all of no avail. There was one significant feature, however, that the pus was of a virulent type. I had it examined, and it was found to be loaded with streptococci and staphylococci. In those types of cases I believe that little can be done to prevent the more extensive complications that may arise, provided the anatomical conditions are favorable for an extension into the mastoid.

Regarding the increase of the number of mastoid cases in this city I question whether or not that is true for the past twelve years. In spite of the epidemics of grippe we are treating about the same proportion of cases now as we did twelve years ago. I presume that in the earlier days many mastoid cases died from meningeal complications and so were never heard of.

As to the prevention of chronic suppuration I have always taught that there should be no such thing as a chronic suppuration when the cases were seen early and were intelligently treated.

Dr. M. D. LEDERMAN: There is no doubt in the minds of otol-

ogists that grippe plays an important part in the affections of the mastoid. Only last week in my service at the Manhattan Eye and Ear Hospital I saw four cases of grippe mastoiditis. Three of these cases were operated upon and the fourth will be. In one case there was extensive disease of the lower part of the mastoid. In another case the whole of the mastoid was involved and the sinus was exposed for over an inch. In the third case, a child three months old, there were symptoms of grippe, sneezing, coughing, with history of grippe in the family; the mastoid was completely diseased. In children we are apt to have suppurative disease of the ear follow any infectious process. In the fourth case there was also a history of grippe; although only a serous discharge existed yet there were evidences of mastoiditis with slight temperature. In three of these cases the temperature was not high.

With regard to the anatomical peculiarities, we are apt to have the suppurative process assume large dimensions in cases where the antrum is low down. If the antrum is high up, with good drainage, we do not find the disease so extensive. I think that accounts for the fact that some cases in which the drumhead is incised get well promptly, while others go on to operation. Here we did not incise the folds of mucous membrane which act as a ball-valve in the middle ear. In such cases we must make deep and extended incisions. I remember distinctly a grippe case in a female, in which an operation was suggested, but she objected to having the mastoid opened. Here the drum was incised three times under an anæsthetic and three times without any result, yet the patient got well under good drainage and regular douching. I believe that absolute rest, free drainage, and the use of hot antiseptic douches are of great value in these cases.

Dr. EDWARD B. DENCH: The paper is certainly an interesting one but, I think, there is one point that has been overlooked, although touched upon. In speaking of the anatomical peculiarities which were prone to cause involvement of the mastoid, and of others in which the mastoid was not involved, I do not remember whether anything was said about the appearance of the parts on otoscopic examination. Where the tympanic vault is the seat of the inflammatory process we are apt to have mastoid involvement. These cases are characterized by the presence of very little discharge when incised. In fact I have repeatedly incised the drum membrane in this situation and I have had the same

experience that Dr. Lederman has had, getting a cracking sound such as is usual when a normal drum membrane is incised, and a puff of gas ; as the knife passed through the intra-tympanic folds there was an escape of gas which had been pent up there, and which was caused by the action of micro-organisms. Such cases are prone to go on to mastoid involvement. Clinically we can decide in a certain proportion of cases whether on the one hand we are liable to have mastoid involvement, or whether the patient is going to escape. If the upper part of the tympanic cavity is involved then look out for trouble. If, on the other hand, the lower part of the tympanic cavity is involved, with the signs of an acute inflammation, such as diffuse redness, everything looking angry, that case will not go on to a mastoiditis. Again, one must remember that the character of the infection makes a good deal of difference and the examination of the discharge from the ear, both by smears and cultures, is of value. Still, I have seen virulent streptococcus infection in which the mastoid was not involved. I have also seen cases in consultation where no streptococci were found and yet when the mastoid was opened it was found to be completely broken down. I am in sympathy with what Dr. Meierhof has stated, and what I have written during the past eighteen months will bear me out. I have placed myself on record not only regarding operating upon the mastoid when it is involved, but also, when in doubt, doing an exploratory operation.

Dr. MEIERHOF, in reply : I am certainly obliged for the discussion which my paper has brought forth, for really that was why I produced it. I did not pretend to tell anything new, but I did wish to get an expression of the members of this Section.

Some years ago I took the trouble to look over the reports of three of the largest institutions in this city which dealt with ear diseases, going back ten years, endeavoring to learn how many mastoid operations had been done ; the three institutions whose records I looked over were the New York Eye and Ear Infirmary, the Manhattan Eye and Ear Hospital, and the Ophthalmic and Aural Institute. In these three institutions during that time they performed as many operations as are performed to-day in two or three weeks at the New York Eye and Ear Infirmary. Now, whether mastoid operations are on the increase, particularly since then, I am unprepared to say ; there may be more cases due to influenza infection, but there were just as many cases of purulent otitis following scarlet fever, measles, and the other diseases of

like character. I said that the mastoid operation was done more frequently now because of the greater confidence of operators in their work; that has resulted in more operations but not in more cases.

I have seen many exceptions to what Dr. Dench has stated regarding the propagation of the inflammation of the upper and posterior part of the drum.

Another object of the paper was to bring out an opinion as to whether the early treatment of acute inflammation of the middle ear does prevent the more serious complications; if such is the case then I think the profession is certainly remiss in not giving this subject the attention it deserves.

A new treatment for deafness from chronic catarrh of the middle ear.

A preliminary report.

Dr. W. H. BATES read this report and furnished the abstract here given.

Abstract.—The author first briefly referred to the pathology of the middle ear and particularly called attention to the presence of connective tissue as an etiological factor. *Indications.*—The cases improved had better bone conduction than air conduction for all the Hartmann series of tuning-forks. The treatment was only employed after other well known methods had failed to benefit the hearing. *Operation.*—The object of the operation was to obtain room for local treatment of the region of the oval window and was not to improve the hearing. An opening was made over the mastoid close to the insertion of the auricle. The posterior superior walls of the bony meatus were removed with a chisel until the antrum was exposed. The drum membrane and ossicles were removed. With the chisel the outer walls of the attic and aditus ad antrum were removed, converting the tympanum, mastoid antrum, and external auditory canal into one cavity with smooth walls. The skin incision was closed with sutures. *After Treatment to Improve the Hearing.*—The object of the after treatment was for the removal and prevention of recurrence of connective tissue from the inner wall of the tympanum. The writer had great difficulty in accomplishing this. As a rule the hearing was temporarily lowered after surgical and other procedures. To prevent infection antiseptic solutions were necessary. The treatment usually extended over several months before much benefit

was obtained and this was in the writer's opinion the only objection to this method of improving the hearing in these cases. *Report of Cases.*—Only twenty had been treated during the past eight years. All were benefited and many to a marked degree. A few who before treatment were unable to hear a watch or ordinary conversation at two feet were practically cured.

Discussion.—Dr. WENDELL C. PHILLIPS: I confess that the boldness of conception, and the patience required, and the radical measures adopted, rather stagger me; at the same time the results shown by the doctor in his paper prove that there may be some possibility of benefiting a small proportion of cases of this class. I can see but one possible excuse for undertaking so radical an operation, and that is when patients have not been relieved after all other modes of treatment have been exhausted in cases of advanced deafness and when they are willing to undergo any treatment that offers to them a hope of restoration of their hearing. I do not think that the results obtained in so few cases will settle the question as to the real value of this procedure. Still, I think there should be some way of accomplishing this result without resorting to measures so radical.

Dr. EDWARD B. DENCH: What most impressed me in listening to the doctor's recital of his cases was the improvement in hearing on the side not operated upon. I am inclined to stand on Dr. Bates's side, for I brought out that point at least seven or eight years ago. That was a point first brought out by Wharton Jones, and has been observed by all careful men since that time, that operative, or non-operative, measures upon the ear of one side will improve the hearing upon the opposite side. I have examined with great interest the cases brought here this evening, and I was much impressed with the perfection in the technique. We must remember that these were not suppurative cases, and I have no experience in operating on such cases. I confess that when I saw the title of the paper the procedure seemed to me to be rather a radical one. I have yet to be convinced of the necessity for such an extensive operation in the large proportion of cases, and I think many here will acknowledge that I am as radical in my work upon the middle ear as any one in cases presenting themselves for improvement in hearing. I am much interested in anything which will give us additional knowledge in this direction.

It is almost always possible to relieve the tension around the

windows (either the round or the oval) through the canal; when that is impossible without removing the floor of the tympanic vault, I can see no objection to the procedure advocated.

Dr. LEDERMAN: I should like to ask Dr. Bates if he can offer any explanation of the clinical fact that the patient still hears better in a noise with the ossicles removed, than when they were present.

Dr. PHILLIPS: I should like to ask if Dr. Bates removed two or three ossicles.

Dr. GEORGE B. MCAULIFFE: It seems to me that Dr. Bates has struck a key-note in the treatment of these conditions which has hitherto escaped observation. Hearing is not due to simply stapedial mobility, but is due to the impact of sound waves upon the tympanic wall. Therefore any operation which tends to reduce the density of this wall improves the hearing. Yet I think that the treatment of Dr. Bates is entirely too radical. I think that measures can be adopted which will relieve the increase in the connective tissue and improve the hearing without resorting to tympanic exenteration.

Dr. JOSEPH KENEFICK: It is interesting to consider the effect of water and its influence upon the connective tissue in the middle ear. In history-taking we are always considering the question of diathesis, and it is a striking point to notice that a large number of people who are complaining of a chronic catarrhal otitis media are afflicted with chronic rheumatism or gouty tendencies. I think the gouty diathesis is an important element in the etiology of chronic middle-ear disease.

Dr. THOMAS J. HARRIS: It was not my privilege to hear Dr. Bates's paper, but through his courtesy I was permitted to see one of his operations a few days ago. Since then I have had no occasion to change my mind regarding this procedure. Disregarding its theoretical or its practical value, the one objection I would raise is as to our inability to get our patients to submit to such a radical procedure. For most of us this operation is going to be as a closed book.

I agree with the chairman and the last speaker in their statements that Dr. Bates is working in the right direction, but I wish he could give us a way to obtain the same results without resorting to such a radical procedure.

Dr. W. H. BATES: In answer to Dr. Lederman's question I can only say that I do not know why patients without a drum mem-

brane hear better in a noise than in a quiet place. I have been working in this field for a long time, and I have tried many things before I resorted to the operation I have just described. To improve the hearing of these patients I wanted to reach the oval window. In the beginning I took out the drum membrane and the ossicles through the canal to accomplish that purpose. But in the chronic catarrhal cases I found this to be insufficient, because a mass of connective tissue had formed a plug in the attic so large and inaccessible that I was unable to remove it and make the hearing better. I remember one patient I had five years ago where I took away the drum membrane, the malleus and stapes, thus exposing the oval window, and yet I was unable to remove sufficient connective tissue to improve the hearing after three months' treatment. Later I did this operation, taking away the outer wall of the attic and the bone about the antrum in order to obtain room, and then I was able to improve the hearing.

DIAGRAMS ON BLACKBOARD.

I have never attempted to obtain this space by operating through the canal, but have always made an opening behind the auricle. With surgical precautions this wound heals by primary union. I believe that this radical operation is necessary in those cases where there is an anchylosis of the stapes and fibrous tissue covering the oval window. With this cause of deafness, *i. e.*, fibrous tissue covering this window, the only thing to do is to remove the stapes and the fibrous tissue.

As to the use of water, English and other physicians have been using it for years. In all cases I order the patient to drink three quarts of water each day both before and after the operation. In persuading patients to submit to this operation I have no trouble at all after I have told them the conditions present and the indications for this operation. When it is explained to them they rarely refuse.

STATED MEETING, HELD MARCH 13, 1902.

DR. HERMAN KNAPP, CHAIRMAN *pro tem.*

Dr. A. KNAPP read a paper published in full in this issue, p. 99.

Discussion.—Dr. EDWARD B. DENCH: We are indebted to Dr. Arnold Knapp for the report of his interesting case. It seems to me that the work of the Society is now in the right direction.

We can all remember the time when no otologist would have attempted such extensive operative measures as Dr. Knapp has described in his admirable paper. At the present time we all believe in dealing with these severe conditions radically, and in their incipiency, in the hope of relieving the patient. A short time ago I reported a case of cerebellar abscess in which the avenue of infection was through the posterior mastoid wall, directly through the lateral sinus. At the time of the operation all carious bone was removed, and careful examination, both by ocular inspection and palpation, by means of the finger and the probe, seemed to show that the bony walls were firm in every direction. For about a week after the operation the patient did perfectly well, the temperature being normal, and the general condition of the patient being in every way satisfactory. At the end of this time the patient suddenly became comatose and died in about three hours. The autopsy revealed an abscess as large as a hazel nut in the cerebellum. The outer wall of the abscess was formed by the lateral sinus, which was necrotic at this point. Examination of the bony covering of the sinus revealed a small necrotic area in the bone, not larger than the head of a pin. This had been overlooked at the time of operation. In this instance the cerebellum was infected by a contiguity of structure, the infection travelling directly through the lateral sinus.

Dr. Knapp's case is particularly interesting, as it shows that the infection occurred through the internal auditory meatus.

Dr. Cl. J. BLAKE read a paper on the **anomalies of tension in the transmitting apparatus in the middle ear** (published in full in this number, p. 89).

Discussion.—Dr. EDWARD B. DENCH: I was very much interested in the paper of Dr. Blake. I think we all agree that when Dr. Blake comes to New York to read a paper before our Society, we are to have what we might call a "mental feast." Certainly, we have not been disappointed to-night. The paper which the author has presented to the Section embodies much careful scientific research,—that sort of work which is done in the laboratory, and is, therefore, more difficult and more tedious to the investigator than the more interesting work which is done in the operating room. Clinically, I have observed interference with the perception of the upper notes of the musical scale, in cases of tension anomalies of the posterior portion of the membrana tympani. It has always seemed to me, however, that this interference with the

perception of the high notes depends not so much upon the inability of the relaxed membrane to conduct the sound waves to the labyrinth, as upon the changes in labyrinthine pressure, which the variations in tension of the drum membrane must cause. As Dr. Blake has said, in some cases of increased labyrinthine pressure the upper-tone limit is elevated — that is, notes of a much higher pitch are perceived than are usually perceived by the normal ear. This seems to me to be merely hyperæsthesia of the labyrinth, due to pressure. In other cases, where the upper-tone limit is lowered, it has seemed to me that this pressure has been so strong or has continued for so long a time as to cause a temporary ablation of function of the lower portion of the cochlea, which, as we know, is that part concerned in the perception of the high notes of the musical scale. We frequently find, in cases where the drum membrane has been drawn inward for a long time, that the upper-tone limit is lowered to a marked extent, but that it becomes normal as soon as the equilibrium of the drum membrane is restored by catheter inflation.

I have made use of the paper discs, described by Dr. Blake, in the treatment of relaxation of the posterior segment of the membrana tympani, and have found the treatment successful in a certain number of cases.

Another tension anomaly which is sometimes met with, is the separation of the malleo-incudal articulation. In one case of this kind, this relaxation of the malleo-incudal capsular ligament was certainly due to pneumo-massage. The patient complained of subjective noises of a peculiar character, such as "crackling" or "snapping" in the ear, particularly when the head was in a certain position. These subjective sounds were also frequently aggravated by certain sharp sounds. In a second patient, complaining of similar symptoms, relaxation of the capsular ligament was due to the firing of a pistol close to the ear. Both of these cases made a complete recovery after the introduction into the canal of a small strip of paper, bent upon itself, and introduced into the canal, so that while the long arm of the bent paper strip rested against the anterior wall of the external auditory canal, the short reflected portion pressed upward and backward against the short process of the malleus, crowding the articulating surfaces of the malleus and incus together. This small paper splint was left in place for several weeks, and upon its removal the distressing subjective symptoms disappeared.

I have also been able to observe, as Dr. Blake has mentioned, the necessity of absolutely normal hearing in all vocalists. I have had patients come to me complaining that in singing they always sang flat. These patients were not conscious of any impairment in hearing. Careful tests, however, showed that musical notes were not perceived equally well with both ears, one ear appreciating the tone correctly perhaps, while the other ear would perceive the sound a half or a quarter of a tone lower. Upon relieving the aural condition, the patients found that they could sing true.

I was glad to hear Dr. Blake say that he considered pneumo-massage injurious. I have certainly seen positive injury follow its employment. There can be no question that the patient experiences a certain amount of temporary relief immediately after the ear has been manipulated in this way; but there is no doubt, also, that it does cause permanent damage in many cases.

Naturally, I am interested in the exploratory operations which Dr. Blake has mentioned, because I have for a long time been a champion of middle-ear surgery. I have, therefore, listened to what he has said upon this subject, with much pleasure. I am glad Dr. Blake believes that in a large number of cases we are warranted in doing an exploratory operation to determine the actual mobility of the ossicular chain. I can say from a large experience that exploratory operations, if carefully performed, do not imperil the organ of hearing in the slightest degree. When the operation is performed under proper technique, suppuration does not follow and the exploratory wound heals readily. It must be emphasized, however, that the strictest aseptic precautions must be observed in performing these operations. The procedure should be conducted with as much care as in performing graver operations upon other portions of the body. When properly done, I am convinced that the treatment of tension anomalies by surgical methods will afford relief to quite a large proportion of cases. I have never performed any of these operations without the use of a local anæsthetic. The first incision through the drum membrane must, of course, be painful, as the intact membrana tympani cannot be anæsthetized. After making a small incision into the drum membrane, it has always been my practice to introduce a sterile 20% solution of cocaine into the middle ear by means of a delicate cotton-tipped probe. In this way, both the margins of the incision and the tympanic mucous membrane are anæsthetized, and the remainder of the operation

can be conducted without the least pain. It has also been my practice in these cases to use a sterile solution of the suprarenal extract, in order to control the slight hemorrhage which is so annoying in these operations. The sterile suprarenal solution is introduced into the middle ear by means of the cotton-tipped probe, and renders the operation practically bloodless.

The point mentioned, in regard to the improvement in hearing which follows in the ear not operated upon, was interesting. I have long insisted upon this fact. The observation is not original with me, but was made first, I think, by Wharton Jones. I have heard it disputed by many eminent authorities, and therefore am delighted that Dr. Blake confirms the observations which I have already made in regard to this point. When I remove the ossicles, in cases of chronic non-suppurative otitis media, in which both ears are involved, I almost invariably operate upon the ear first affected, and it has been my experience that even where improvement in the ear operated upon is but slight, the opposite ear not infrequently improves considerably. If we can operate upon the case before there is even pronounced labyrinthine involvement, then we can usually improve the hearing. If, however, the labyrinth of either side is involved to any extent, the outlook for improvement, as the result of operative treatment, is poor. In these cases we usually find that the inflammatory process beginning in the middle ear of one side gradually invades the labyrinth. When the ear of the opposite side becomes involved, it is usually the labyrinth which is first affected, and not the middle ear. If, then, by operating upon the ear first involved we can relieve the pressure upon the labyrinth of that side, labyrinthine involvement upon the opposite side will either not take place, or will take place very slowly. Experience has taught me that we are able to do a good deal for these patients if sufficient care is used in selecting proper cases for the operation. I am sorry Dr. Blake did not say what operative procedures he considered the best. My own experience has been that where, after an exploratory operation and freeing the stapes, the patient's hearing improves, this improvement is rendered permanent by removing the two larger ossicles and the drum membrane, so that the stapes can be directly under ocular inspection, and also so that it can be mobilized mechanically from time to time, if necessary. At a later period, it is possible by means of paper discs or a mushroom-shaped cotton-pledget, applied directly over the head of the stapes, to

secure considerable mobilization of this ossicle by the action of sound waves which are continually entering the ear. I have found that the membrana tympani is not usually reproduced after it has once been removed. Occasionally it re-forms, but after removal a second time, is seldom again replaced.

Dr. WILLIAM H. BATES: I should like to ask if anything can be done to permanently increase the tension of the relaxed drum membrane.

Dr. BLAKE: Relaxation is most likely to occur in the posterior segment, and an application of collodion is, usually, the best means of dealing with it; the collodion not only gives protection to the stretched portion, but also a mechanical contraction which favors the return of the parts to their normal condition.

Dr. MAX TOEPLITZ: Six years ago I reported to the New York Otological Society the case of a musician, a member of the Metropolitan Opera House Orchestra, who played the violin; when he reached a certain note he experienced such peculiar symptoms that he stopped playing. He was so distressed by the tinnitus and rattling that he gave up his profession at the time. I tried the rubber discs mentioned by Dr. Blake years ago, in a former publication. I should like to ask if a similar observation has been made by any one, where certain musical notes of an instrument affected the tension of the middle ear.

Dr. BLAKE: I have seen such cases responsive to sustained musical tones, especially those produced by the violin, and also cases in which there was loss of the qualitative overtones, the result apparently of a relaxation of the articulation, but to have responsive sympathetic vibrations, giving peculiar sensations with particular notes, is certainly very rare. In some of these cases it is possible to detect the portions of the drumhead involved by touch with a light probe, gentle pressure abolishing the sympathetic vibration; in some cases the use of the collodion film helps toward detecting the relaxed portion, when by means of a magnifying-glass a light spot can be seen, but the use of the probe is usually the best.

Dr. THOMAS J. HARRIS: I should like to ask Dr. Blake if he will, in closing the discussion, touch upon pneumo-massage, *i. e.*, if he excludes it from his routine work and only uses it in certain cases.

Dr. BLAKE: Such cases occur with great thickening and great immobility, but stretching the drumhead is more easy than we

think. My experience with the effects of pneumo-massage has taught me that it takes a long time to recover from the considerable stretching effected.

Dr. FREDERICK WHITING: I think Dr. Blake's paper particularly seasonable, because in our recent meetings mastoid surgery and its intracranial complications have engrossed the attention of all our members to the entire neglect of a branch of otology which, if less brilliant in its results, is at least equally worthy of discussion and study. Dr. Blake's classical contribution is difficult to discuss, because of the very advanced teaching which it offers, and because his experiments and experience with anomalies of tension in the sound-conducting mechanism is so far superior to that of most practitioners. I certainly agree with him that any line of study and research which renders more comfortable and happy the lives of a class of patients whose disability if unrelieved entails long years of misery, is as praiseworthy an achievement as a surgical operation which in an inflammatory disease may save life. I would like if the Doctor would state more at length his experience in relieving tension anomalies by mechanical, surgical, or other means, and how great reliance he places upon remedial measures directed toward the correction of allied tension of the posterior segment of the membrana tympani.

Dr. BLAKE: In even marked cases of stretched posterior segment, simple applications of collodion suffice in time to restore the normal tension. This treatment must be repeated at long intervals, and must be kept up for a long time. In some cases the application of collodion may be continued for a year or more, application being made once in three or four weeks only, and coupled with the Hommell massage. In the more severe cases, where the stretching is very considerable, a cone-shaped drum of fine fibres of silk interlaced with wax as a binding medium may be employed in the first stage of treatment. They can be easily adjusted and kept in position, remaining for two, three, or four weeks, until they are gradually removed by the normal growth outward of the lining membrane of the canal. In the more serious cases of posterior-segment relaxation, where the parts can be easily moved to and fro, the posterior segment may be incised and attached to the descending process of the incus. In this way union between the posterior segment and the incus is obtained, with the result of restoring the transmission of the qualitative overtones.

Dr. E. GRUENING: In this interesting paper "On the Anomalies of Tension in the Membrana Tympani," I hoped to find for my own information some pathological observations regarding the part of the intrinsic muscles of the ear. Experimental research has failed to define the function of the tensor tympani muscle. This is also true with regard to the stapedius. The remarks of the speaker seem to show that he regards the tensor tympani as a muscle of accommodation. I should like to ask the speaker his reasons for this view.

Dr. BLAKE: The assumption that the tensor tympani is a muscle of accommodation is borne out by its anatomical structure, a long-bellied muscle with short bundles of fibres which, acting successively, are capable of keeping up a sustained tension which exerts itself unduly when the posterior segment becomes relaxed.

Dr. M. D. LEDERMAN: I should like to ask Dr. Blake if he has ever come across any cases in which contraction of the tensor tympani muscle was voluntary.

Dr. BLAKE: Voluntary contraction of the tensor tympani has been found to carry the hearing limit upward from five thousand to ten thousand vibrations; such cases are rarely detected except in musicians.

Dr. LEDERMAN: I have the power of contracting my tensor tympani at will. By placing your ear close to mine you can hear a distinct sound.

Dr. BLAKE: I should like to ask Dr. Lederman if, in exercising such a contraction, he is conscious of the action of adjacent muscles.

Dr. LEDERMAN: No, but I can voluntarily contract some of the extrinsic muscles which are attached to the auricle. The tensor-tympani contraction is independently a voluntary act.

Dr. BLAKE: There is a physician in Boston who can do this beautifully, but he also is a musician. He contracts the tensor tympani without apparent effort, and the hearing of the tone to which he is listening rises in pitch. I believe that, in doing this, he makes an effort with other muscles, and that the voluntary power over the tensor tympani muscle is not so complete as to enable it to act without assistance from adjacent muscles.

Dr. BLAKE: In writing this paper I had in mind the operation to which Dr. Whiting refers. In cases where Kessel's operation has been done, the head of the stapes is drawn against the tip of the pyramid by contraction of the stapedius, and the hearing is

consequently poor; by doing a tenotomy and restoring the mobility of the stapes, then introducing a cotton vaseline drum, the hearing is improved. Tenotomy of the stapedius is an important addition to the operation of Kessel.

In the hearing of the tuning-fork by bone-conduction it is sometimes a question as to whether the tuning-fork vibrations are conveyed directly through the bones of the head or transmitted through the medium of the sound-transmitting apparatus to the labyrinth. Apparently the sound waves travel in both directions, and in this connection Dr. Knapp's theory, that the sound-transmitting apparatus is a control apparatus, should be had in mind, there being many cases in which hearing by bone-conduction is restored by opening the Eustachian tube, and inflating the ear. I should like to ask Dr. Knapp if he has continued his investigation as to hearing by bone-conduction.

Dr. HERMANN KNAPP: I have never made any experiments on bone- and air-conduction. By analogy of the perceptions by the other of the higher senses, that of sight, I have thought that bone-conduction would give us quantitative perception of sound, as we perceive light and darkness when we close our eyes, but the distinction of form or color only through the refracting apparatus. In the same way we might require the help of the terminal apparatus, the membrana tympani, ossicles, etc., to differentiate sound impressions into their qualities, pitch, intensity, and color. The phonograph lends support to this hypothesis by receiving the sound waves and recording them on a movable plate, which in return sends the tracings back into the ear, where the membrana tympani takes them up and transmits them, as to pitch, intensity, and clang tint (timbre), to the perceptive apparatus in the cochlea.

Dr. BLAKE: I should like to ask Dr. Dench as to his method for performing exploratory tympanotomy.

Dr. Dench: (Black-board illustration.)

Dr. BLAKE: Within the last few years a maximum of papers read have dealt largely with surgery, *i. e.*, surgery of the brain and surgery of the mastoid, and there has been a paucity of papers upon other subjects, equally important to the progress of otology.

Executive Session: The following resolutions were passed:

NEW YORK ACADEMY OF MEDICINE.— SECTION ON OTOLOGY.

RESOLUTIONS ON THE DEATH OF EDWIN M. PYLE, M.D.

WHEREAS, it has pleased the Almighty to suddenly call from us our esteemed and respected colleague, Dr. Edwin M. Pyle, and,

WHEREAS, for several years past he had zealously devoted himself to the special field of Otology, distinguishing himself in the hospital by his unselfish industry and superior skill as an operator, and winning in these meetings the esteem and admiration of his colleagues for his sincerity of purpose and genuine devotion to the advancement of this branch of medical science,

Therefore be it Resolved, That while we accept submissively the decree of Divine Providence, the members of this Section as associates in the field of Otology and as co-workers in the New York Eye and Ear Infirmary, to which deceased was attached, desire to record the sense of loss which they have sustained in the sudden taking away of their fellow practitioner, and,

It is further Resolved, That the members of this Section extend to the family and friends of the deceased their heartfelt sympathy and sincere condolence in their bereavement, and that these resolutions be spread upon the records and a copy be sent to the family and to the medical journals for publication.

Signed { JAMES F. MCKERNON, M.D.,
FRANK J. BLODGET, M.D.,
JOSEPH KENEFICK, M.D.,
Committee on Resolutions.

March 13, 1902.

REPORT OF THE TRANSACTIONS OF THE NEW YORK OTOLOGICAL SOCIETY.

By Dr. ARNOLD KNAPP, Secretary.

MEETING OF MARCH 25, 1901. THE PRESIDENT, DR. H. KNAPP, IN THE CHAIR.

PRESENTATION OF PATIENTS.

Dr. Wilson presented a case of **empyema of ethmoidal and frontal sinuses** in a woman of seventy-two years, who had suffered for two years with headache and had been conscious of a growth in her nose. A fluctuating tumor formed at the upper-inner angle of both orbits, pushing the eyes down and out. At operation, an incision was made along the upper and inner margin of the left orbit and about two ounces of pus were evacuated. A cavity lined with smooth membrane was encountered, communicating with the other orbit. There were no granulations or carious bone. The case did well. The eyes returned into place, and the patient now has a fistula on the site of the original incision, which admits a probe, allowing it to pass in various directions to the depth of two inches.

Discussion.—Dr. Gruening had recently operated on a similar case. The patient had complained of pain in the eye. Herpes corneæ and slight ptosis were present and there was tenderness over the lower wall of the frontal sinus. The sinus was opened and a considerable amount of pus evacuated. The entire lower wall was removed according to Jansen's method. The antrum of Highmore was then opened and it also contained pus.

Dr. Whiting said that he had operated on a case seven years ago. A fluctuating tumor was present which he simply opened and treated as a mastoid empyema. The case healed readily.

Dr. Kipp had operated on a case of empyema of both frontal

sinuses where he removed the entire anterior wall of the septum. The case recovered with very little deformity. In another case of empyema where the patient died of non-septic pneumonia, the frontal, ethmoidal, and sphenoidal sinuses of one side were converted into one cavity; no trace of mucous membrane remained, and sharp spiculæ of bone projected from all sides.

Dr. QUINLAN had operated on 17 cases; 11 were single and 6 were double empyemas. He was in the habit of making his incision along the upper margin of the eyebrow; all the diseased bone and granulation tissue were removed, light packing introduced, and the wound allowed to heal by granulation. Drainage by the nose is disregarded and rather avoided as re-infection often occurs from that locality. If any deformity results, such as a depression, paraffine injections are resorted to and the cosmetic result accomplished is all that can be desired.

Dr. ARNOLD KNAPP asked what was the condition of the nose in Dr. Wilson's case. Dr. WILSON replied that before operation a probe had been forced into the cavity though the right nostril for diagnostic purposes, evacuating some pus. In conclusion Dr. Wilson said that he thought it was unusual to find so large an abscess cavity without any dead bone or granulation tissue, and he regarded it as a case of mucocele with absorption of bone by pressure.

Dr. HERMAN KNAPP spoke of the complications resulting from the **extension** of the suppuration **in two directions,** the one into the **cranial cavity,** producing pachy- or leptomeningitis and cerebral abscess, the latter frequently marked by no other cerebral symptom than a certain degree of fretfulness; he recalled a marked case of that kind where there was only a slight fistula at the junction of the middle and temporal thirds of the supraorbital margin. The abscess in the frontal lobe was found only at the autopsy. The **second direction** of the extension is toward the **other pneumatic sinuses of the face,** causing not infrequently neuroretinitis and blindness. A marked case with such sequences had been observed by him in consultation. Dr. Abbe opened the frontal and sphenoidal sinuses and tried to establish drainage by introducing a band of aseptic gauze through the frontal and sphenoidal sinuses into the pharynx. The band had to be removed the next day, being unbearable. The patient recovered, but remained blind.

Dr. KENEFICK presented a patient, aged twenty-five, with **disturbance of equilibrium,** who had received a glancing blow from a bullet when three years of age. The scar of a scalp wound at the upper border of the right parietal bone could still be seen. She had never been able to walk in a straight line, and on standing with her eyes closed unconsciously fell backward and to the right side. There is evidence of beginning middle-ear sclerosis but none of definite labyrinthine involvement. The opinion of the Society was asked regarding the probable site of the lesion.

Discussion.—Dr. BACON asked whether any weakness or paralysis of the seventh nerve had been observed, and whether the patient had been examined by a neurologist. Dr. Kenefick replied, No.

Dr. H. KNAPP thought there was slight facial paralysis present, the patient having a tendency to draw her mouth to the right side. He further quoted some cases published by Politzer, of old fractures of the base producing similar symptoms.

Dr. DENCH thought that in all probability there had been a fracture at the base of the skull upon the right side from the impact of the bullet upon the convexity of the cranium. It also seemed likely that this fracture had passed through one of the semicircular canals, probably the horizontal, and that this lesion accounted for the vertigo.

Dr. KIPP cited a case of a boy who had a tendency to fall always to one side. A cerebellar tumor was suspected and found to be situated in the middle line.

Dr. ARNOLD KNAPP presented a patient on whom a **radical operation** had been done with **primary skin grafting.** A single Thiersch graft was applied to the labyrinth wall and facial spur. This had simplified and shortened the after-treatment. During the operation the stapes was inadvertently extracted, and the patient's hearing after operation has decreased, contrary to the experience recently published.

Dr. DENCH said he had never applied skin grafts according to the Thiersch method at the time of the primary operation. He reported a case operated upon several weeks ago in which the patient, a man, came to the clinic with the history of an acute mastoiditis. At the time of operating there was a fluctuating post-aural tumor. Upon incision of the soft parts and entering the mastoid in the typical manner, the entire mastoid was found to be broken down. The tympanum had evidently been the seat of a suppurative process for a number of years. The destruction of

the bony tissue was so extensive that during the operation the lateral sinus was exposed, and a large dural area was also laid bare at the floor of the middle cranial fossa. A complete operation was done at this time, but owing to the extensive exposure of the intracranial structures, it was not deemed wise to close the wound. Two quadrilateral flaps were cut from the concha and meatus and were pushed, the one upward and backward and the other downward and backward into the posterior wound by means of an iodoform gauze packing inserted into the external auditory canal. The posterior wound was also packed, in the usual manner. At the end of a week, as the patient's temperature had remained normal throughout, and as the wound was in excellent condition, these meatal flaps were sutured in position and the posterior wound entirely closed. At the end of a week the posterior wound had healed throughout, but the large surface covered with healthy granulations, comprising the entire middle-ear and mastoid cells, was left exposed through the external auditory canal. As the external auditory canal resulting from this plastic operation was very capacious, Thiersch grafts were applied through the meatus, the posterior wound not being opened. These grafts took perfectly, and the entire cavity was covered with epidermis in the course of a couple of weeks.

Dr. WHITING asked Dr. Knapp how the graft was retained in place and what dressing was applied. Dr. KNAPP replied, By simple pressure and plain gauze dressing.

VOLUNTARY CONTRIBUTIONS.

Dr. BACON reported the case of a child who, after **severe measles,** suffered from earache; temperature 104°. There was a perforation of the left drum, and the right drum was congested. A free incision was made in each drumhead. From the right ear otorrhœa set in; temperature went down. Some bronchitis was present, and three days later, the temperature having again risen, the paracentesis openings were enlarged. Mastoid processes were tender; temperature went up to 104.5°; both mastoids were opened. Pus and broken-down tissue were found. Temperature dropped 2°. Respiration 52. General condition poor. The patient vomited more or less the two days following the operation, and on the third day she died. The temperature varied from 102.2° to 102.8°, pulse 130, and respiration 40–52. Although

pneumonia was suspected, the physical signs could not be made out.

Dr. Bacon asked for information as to whether other members of the Society had met with severe complicating mastoiditis after measles.

Discussion. — Dr. GRUENING reported a fatal case of otitis after measles in a girl fourteen years old. She had had earache on the seventh day. The drumheads were slightly red. Paracentesis evacuated serum. The mastoids were very tender; temperature 106°; patient delirious; symptoms of meningitis pronounced. Mastoids were opened and found filled with pus and carious bone, the diseased process having exposed the sinus. Sinus appeared normal. On the third day pyæmic temperature set in and the sinus was incised. On incision about one ounce of clear serum was evacuated. Below, a clot was found. Jugular was tied. Patient died. Autopsy not permitted. In another case the disease resembled an osteomyelitis of the mastoid where the ear was secondarily involved. Fatal termination.

Dr. KIPP had also observed some severe cases of otitis after measles and had lately had a case which again demonstrated the necessity of ophthalmoscopic examination early in the disease. In a case of otorrhœa, of only a few weeks' standing, the mastoid was tender, there were no fever and no symptoms pointing to intracranial disease, and yet double optic neuritis was present. Thrombosis of transverse sinus found at operation.

Dr. BRANDEGEE had observed a case of **severe measles** followed in two weeks by otorrhœa. Mastoid was tender. At operation the bone was found necrotic, and fetid pus was present. Sinus exposed. The patient apparently recovered. Two weeks later temperature rose to 104°, then 106°, and dropped on the following day. The pyæmic character continued for two weeks. The patient recovered. Dr. Brandegee thought it very unusual to encounter this pyæmic infection at so late a date.

Dr. DUEL in quite a large experience had found that the mastoid was rarely involved in a straight case of measles. He also thought that otitis does not so frequently follow measles as it does scarlet fever and diphtheria.

Dr. DENCH had recently operated upon a case of **severe mastoiditis**, in which, during the course of the operation, the sinus was exposed. The patient did very well, and was discharged from the hospital at the end of about two weeks. Six weeks after the

operation, the patient complained of feeling poorly and was readmitted to the hospital. About twenty hours after admission, the temperature suddenly rose to 106°. During the next twelve hours the temperature fell to normal, but in the course of the next twelve hours, again rose to 106°. The wound looked perfectly healthy, the external auditory canal was dry, and there was a diffuse, brawny swelling occupying the region of the parotid gland on the affected side. The patient was immediately anæsthetized and the lateral sinus exposed in the former operation wound. The sinus contained a softened clot. Upon the removal of this by means of the curette, hemorrhage was obtained from above, but none occurred from below. The jugular was then exposed in the neck from the clavicle to the base of the skull. The vein appeared normal up as far as a point where the facial vein was given off. From this point to the entrance of the vessel into the jugular foramen, the walls of the vein were very much thickened. The vessel was excised from a point just above the clavicle to a point just below the jugular fossa, all tributary vessels being divided between two ligatures. The upper portion of the vein was found to contain a soft, pulpy clot. The patient made a complete and uneventful recovery.

Discussion.—Dr. WHITING wished to know whether any suppurating process remained in the middle ear after the first operation.

Dr. DENCH replied that the ear had been practically dry.

Dr. GRUENING spoke of **late sinus infection.** A boy aged five had the grip. The ear became infected; paracentesis was performed. Mastoid tender. Other ear then became involved. Both mastoid processes were opened, both sinuses being exposed at operation. Temperature went down for two weeks, then went to 102°, 103°, and reached 105° on the third day. Both sinuses were incised. Temperature remained high. A swelling appeared in the groin. Evidences of pneumonia set in; respiration 50. The pneumonia took a rather prolonged course, and then the sterno-clavicular joint was found involved. After this had disappeared, patient complained of pain on urination. An epididymitis was found present and subsequently also disappeared.

Discussion.—Dr. WHITING wished to know whether the incision made in the sinuses had been sufficient to obliterate them. He thought that this point was of great practical interest. Dr. GRUENING replied that the incision was repeated on the third day,

and profuse hemorrhage again occurred, showing they had not become obliterated.

Dr. WHITING reported a case of **extensive pyæmic infection.** The patient had been treated for typhoid fever and had an old ear trouble. On approaching the patient, he was struck by the great odor. The patient had been suffering from septic diarrhœa, with a temperature varying between 99° and 107°, having regularly three to five very severe chills daily. The patient was semi-comatose. The joints were painful, and there was infiltration along the anterior border of the sterno-mastoid and the internal jugular vein felt like a hard cord. Intense neuro-retinitis. Dr. Whiting reluctantly consented to operate, and found the mastoid process and sigmoid sinus completely disintegrated. The jugular vein down to the omo-hyoid was converted into an abscess cavity. Below this the vein contained pus. The origin of the sterno-mastoid was reflected and the junction of the jugular and innominate veins was exposed. A ligature was applied at this point; the innominate veins also contained pus. The patient died three days later.

Dr. HARRIS reported a case of **tubal occlusion.** This had followed an old ethmoiditis—which was about cured. There was no stricture or true stenosis. A medium-sized bougie enters middle ear without obstruction, and is always followed by loud inflation sound. Otherwise cauterization yields little response. Adrenalin applied to walls of canal has effect similar to bougie. Electrolysis and solution nitrate of silver proved unavailing.

Dr. KENEFICK asked whether scarification had been practised at the pharyngeal ostium of the tube. Dr. DENCH thought that the case was similar to one where he had believed that he had to deal with a fold of mucous membrane obstructing the tube, and that a bougie acted in overcoming the impediment.

Dr. Dench thought the case was similar to several which he had seen in which the pharyngeal orifice of the Eustachian tube was somewhat obstructed by folds of mucous membrane. In these cases, catheter inflation is difficult and sometimes impossible unless by gentle manipulation the instrument is crowded past the folds of mucous membrane. Under these circumstances we frequently find that by a little skilful manipulation a bougie will pass completely through the tube, although catheter inflation has been unsatisfactory or even impossible. Careful and skilful

manipulation of the catheter will often make the diagnosis perfectly clear.

Dr. QUINLAN was of the opinion that the case was one of **vaso-motor congestion**—due to a **sympathetic stasis in the pharyngeal vault.** An application of 2 per cent. chloride of zinc, briskly rubbed so as to deplete these tissues, often gave immediate and permanent relief when repeated cauterizations failed to accomplish the purpose.

III. **Atlas and Epitome of Otology.** By GUSTAV BRÜHL, of Berlin, with the collaboration of Prof. A. POLITZER, of Vienna.

Authorized translation from the German, edited by Dr. S. MACEWEN SMITH, of Philadelphia, with 244 colored figures on 39 lithographic plates and 99 text illustrations. Philadelphia and London, 1902. W. B. Sanders & Co. Price $3 net. Cloth.

This is one of the series of medical hand-atlases which were written by competent men at the invitation of the Munich publisher, J. F. Lehmann, and translated into English by initiative of the enterprising Philadelphia publishing house of I. F. Saunders & Co., to whom English-speaking physicians owe a real debt of gratitude, for the reviewer knows of no series of medical text-books that is so excellent, and yet so moderate in price. It seems impossible that an atlas of so many colored or other illustrations could be published in German or English for $3, if the two firms did not arrange to divide the expense in some way. The greatest profit of such an arrangement is surely received by the physicians and their patients, who benefit most by this rapid exchange of every progress in the science and art of healing.

Otology now takes rank among the important branches of medicine, as it ought to, having to deal with one of the higher senses.

We know of no sort of publication more appropriate to learn its essentials from than this atlas, supplemented by a text-book, also profusely illustrated, 292 small 8vo pages, well printed on good paper. The reviewer begs to point out some of the plates, to give an idea of what they present. Plate viii. has four pictures of transparent temporal bones, the labyrinths injected with mercury. Such specimens were much admired at the last International Congress of Otology in London, three years ago. Plate x. has two

very well executed and instructive illustrations of the mastoid and middle-ear spaces, as well as the cranial cavity; in the one picture with the dura removed, giving an admirable survey of the field, a thorough knowledge of which has now become so necessary. A very fine plate is No. xii., showing the application of the catheter in a transparent half-head, in which all the accessory cavities of the nose were injected with Wood's metal. Plate xxiv. presents good pictures of caries of the tegmen tympani, the perforation in the bone, and the small puckered fistula in the dura. Plate xxix. illustrates by six figures the usual methods of opening the mastoid, with Körner and Panse flaps. A good many plates are devoted to the pathology of the soft parts. The atlas occupies almost half the thickness of the work.

The **Epitome** describes, in text-book manner, the anatomy and physiology of the ear, the physical and functional examination, including bacteriological and histological examination.

	Pages.
General pathology, treatment and general hygiene of the ear	146
Special pathology of the ear	147 to 275
Index	279

This book needs no recommendation. It speaks for itself.

H. K.

IV. **Die Berufskrankheiten des Ohres und der oberen Luftwege.** Von Dr. F. Röpke. Solingen, 1892. J. F. Bergmann, Wiesbaden.

This is the first attempt to describe the professional diseases of the ear and upper respiratory passages. The author, living in an industrial centre, has had ample opportunity of making many investigations which are of value not only to aurists but will serve to point out the necessary prophylactic measures. Dr. Röpke has studied the various industrial branches and has examined the mechanics at their place of work. The largest part of the book deals with the professional diseases occurring among those employed in mines, chemical factories, iron foundries, etc.; those peculiar to agriculturists, soldiers, and others leading an out-door life are also discussed. A complete review of the literature adds to the value of the book.

A. Hartmann.

V. **La surdi-mutité.** By Dr. Saint-Hilaire. Etienne, 1900. Maloine, Paris.

This most recent and exhaustive treatise on deaf-mutism deals

with the etiology, pathology, symptomatology, diagnosis, prognosis, prophylaxis, and treatment. A statistical survey of the geographical distribution is given with special reference to the French Departments. Heredity, consanguinity of the parents, stigmata of degeneration, are fully treated. The presence of deafness without mutism in the relatives of deaf-mutes in ascending and collateral lineage is of extreme importance. 153 autopsy-reports are given. The clinical material of the author comprehends 187 deaf-mutes, inmates of the institute at Asnières near Paris. Hearing tests have verified Bezold's findings, and the author has also found the six Bezold groups. The tests were not made with Edelmann's instruments but with a series of König's tuning-forks and rods. As regards the possible development of hearing remnants, the author is an ardent supporter of Bezold's views, though he does not agree with the optimistic views of Urbantschitsch nor the pessimistic ones of Politzer. Due attention is paid to the voluminous literature of the subject. SCHWENDT.

VI. **Die otitischen Erkrankungen des Hirns, der Hirnhäute und der Blutleiter.** Von Professor O. KÖRNER, Rostock. Third edition, 1902. J. F. Bergmann, Wiesbaden.

Professor Körner's well-known monograph has appeared in a third edition. The book is enlarged and the subject-matter has been rewritten and brought up to date. The number of brain abscesses operated on has been increased from 92 (last edition) to 267, and sinus-thromboses operated on from 79 to 314. The chapters on serous meningitis and so-called osteo-phlebitic pyæmia have been rewritten, while chapters on the value of lumbar puncture and on operations in leptomeningitis have been added. It is one of the standard works in this field. A. K.

VII. **Some Thoughts on the Principles of Local Treatment in Diseases of the Upper Air Passages.** By Sir FELIX SEMON, M.A., F.R.C.P. London: Macmillan & Co., 1902. Price, 2/6 net.

Two lectures on the above subject by this eminent writer have now appeared in book form, and their increased accessibility will be welcomed by many. Beginning with a protest against operative intemperance, the author shows how the therapeutic advance due to increased accessibility of a part of the body to examination which was followed by a change from general to local treatment, is apt to be overshadowed by an exaggeration of the latter. To

avoid this unfortunate tendency, certain guiding principles are brought forward in a discussion of a number of affections of the upper air passages. Among those of especial reference to otologists are the following. The question of operation in adenoids depends on whether they cause (*a*) permanent; (*b*) periodical and transitory; (*c*) no symptoms. In the first variety, the advisability of operating is acknowledged by all. In the second, the author advises to wait, unless an aural complication, glandular swelling in the neck, or a tuberculous family history be present. In the third, do not operate. If the operation is indicated, a strong plea is made to operate thoroughly under anæsthesia. We were very much interested to see that the author considers the dangers of lesser degrees of nasal insufficiency to the auditory function, and the influence of slight nasal abnormities (spurs, mucous swellings) on sclerotic middle-ear disease, to be grossly exaggerated. Conservatism in specialistic surgery has often been preached and still remains in order. This little volume will be read with interest by all and with profit by many. A. K.